WOLF3D V3.0

Fuel Injection and Ignition Control Computer

Wolf3D Version 3.0
Rev A

PO Box 532 Ringwood, Victoria, 3134
Australia

Last Updated 22/07/99 1:06
W3dv3_0 manual

TABLE OF CONTENTS:

1. Introduction

1.1 System Overview

The AEM WOLF3D Fuel Injection Computer is one of the most versatile, complete and cost competitive Digital Programmable Fuel Injection and Ignition Control systems available. The system consists of two units. The WOLF3D Hand Controller has two main functions. Primarily, it allows the many parameters of the WOLF3D Engine Management System (EMC) to be tailored to suit a specific application, without the need for an external (PC) computer. Secondly, it can be used as a powerful diagnostic engine monitoring display, with information displayed in both numeric and bargraph form, as well as Min-Max data logging. EMC inputs such as engine rpm, temperatures and load conditions, as well as outputs such as injection and ignition timing, are displayed. It features a backlit screen for easy and convenient night vision. Plug in Memory Cartridges can store all user adjustable parameters in seconds.

1.2 System Applicability

The WOLF3D system can be configured to run many 4 Stroke applications including normally aspirated, turbo/super charged, 4, 6, and 8 cylinder operation and has a special Rotary engine mode. The flexibility of the WOLF3D allows various injector combinations with both banked and staged injection for high flow applications available. Both distributor and multi-coil ignition systems are supported using external ignition amplifiers.

For two stroke and other engine configurations, please consult Advanced Engine Management .

This manual has been designed to be read from front to back. The installation information begins in Chapter 2. If you follow the manual in this way, you will have a quick, neat installation with a minimum of fuss.

WARNING

Before applying power to the WOLF3D EMC, read the section regarding security PIN number programming. The PIN can only be set once. It cannot be modified without returning the WOLF3D to the place of purchase.

2. How Electronic Engine Management Works

The processes the Engine Management Computer (EMC) goes through to run your engine can be broken down into four areas:

1. **Input Trigger**

   The Input Trigger is usually a cam or crank trigger, or a signal from the negative side of the ignition coil. This information can give the EMC information about the speed and position of the engine at any given time. This is one of the most vital elements in the chain in ensuring that the engine is given the correct amount of fuel, and spark at the right time.

2. **Input Sensors**

   Air Temperature, Water Temperature, Throttle Position, Battery Voltage, Manifold Vacuum, and Air Pressure are all taken into account when determining the correct amount of fuel to deliver.

3. **ECU Function**

The WOLF3D Engine Management Computer uses Fuel and Ignition Maps to determine the engine's Fuel delivery and Ignition timing requirements under all engine LOAD and RPM values.

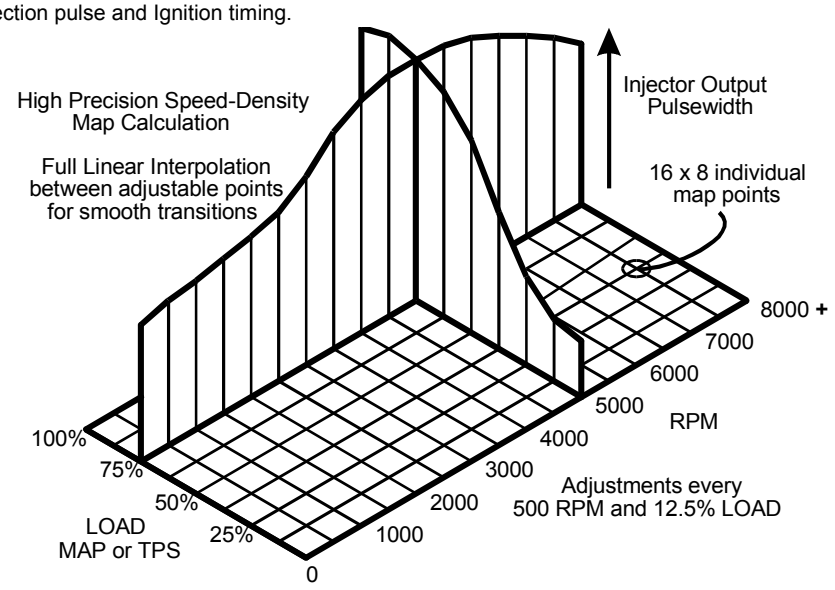
A Fuel Injection Map is a three dimensional Map, with the horizontal axis' being engine LOAD and RPM, while the vertical axis is the injection time. An Ignition timing Map would appear similar, with the vertical axis being Ignition advance in relation to crankshaft position rather than Injection time.

Both the Fuel and Ignition Maps are divided into LOAD and RPM Bands.

The engine LOAD is represented by a scale from 12 - 100%. This range is divided into eight levels:
12% 25% 37% 50% 62% 75% 87% 100%.

The fuel and ignition maps are adjustable every 500 RPM from 500 to 8000 RPM. If the RPM is greater than 8000, the fuel delivered and ignition timing given to the engine are the same as the 8000 RPM values. RPM Bands are divided in sixteen levels: **500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500 7000 7500 8000**

NOTE: The WOLF3D uses linear interpolation between the four closest Map Points to the actual engine condition. This assures the most accurate Fuel Injection pulse and Ignition timing.



4. **Outputs**

The Wolf3D has many output functions. The main two are fuel injector drivers, and ignition outputs. Others include, fuel pump, thermo-fan, and idle air control valve.

2.1 Engine Load Sensing

The engine LOAD is calculated using the manifold pressure by a Manifold Absolute Pressure Sensor, (MAP) Sensor or the Throttle Position Sensor (TPS). The system can be configured to use MAP or TPS for the main Map look-up for the LOAD parameter. When the MAP is used for LOAD readings, the Acceleration Enrichment can be configured to trigger off either MAP or TPS (if connected).

NOTE: To stop any fuel being injected while cranking, hold the throttle wide open. This function is called Flood Clear and the Hand controller will display the millisecond time as 0.00FC. Flood clear mode will only occur while cranking with a correctly setup and calibrated Throttle Position Sensor. For Throttle Position Calibration information refer to section 5.4.

VAC system is used when:
-Supercharged
-Turbocharged
-Plenum with stable vacuum readings

TPS system is used when:
-Individual Throttle Bodies (No plenum chamber after Throttles)
-Plenum with low or highly fluctuating VAC readings

Refer to your AEM Distributor for more information when choosing the appropriate LOAD sensing for a particular engine type.

2.1.1 Manifold Absolute Pressure (MAP) Sensor

The MAP Sensor tells the computer how much load the engine is under. This information is displayed on the primary screen as VAC in kPa and Bst when there is positive manifold pressure. When the EMC is turned on, it samples the atmospheric pressure and uses the value to compensate for the changes made to engine Fuel and Ignition requirements caused by atmospheric pressure changes.

All WOLF3D EMC's are equipped with an internal MAP Sensor, which requires only a vacuum line connection between the EMC and the intake system, downstream of the throttle plate when using the MAP Sensor for LOAD sensing. A stable and constant vacuum source must be used if engine load is to be sensed this way.

TPS LOAD sensing configurations may use the MAP sensor for intake air density correction. Used in this form, the MAP vacuum line can be either left unconnected, vented to the engine bay or connected to the intake air box upstream of the throttle plate for air density correction due to intake ram affects.

2.1.2 Throttle Position Sensor

The Throttle Position Sensor (TPS) is directly connected to the throttle plate via the throttle shaft. It measures the angle of the plate and can be used for both LOAD calculations and transient fuelling enrichment's. This information can be used to determine either the LOAD value and the Acceleration Enrichment, or the Acceleration Enrichment only.

Throttle position is displayed as TPOS on the Main Screen as a value from 0 - 100 (00).

If the TPS Sensor is to be used for **Acceleration Enrichment only**, the engine's original Throttle Position Sensor may be compatible with the WOLF3D and may be used. See section 5.4 for more information. The TPOS value must operate in a smooth incremental manner for at least half of the throttle travel from a throttle closed position. **A "switch" type throttle position sensor is not compatible with the WOLF3D.**

If the TPS is to be used for LOAD sensing, an AEM Throttle Position Sensor may have to be used. The TPos value must be continuously variable from closed to open throttle. **A "switch" type throttle position sensor is not compatible with the WOLF3D.**

2.2 RPM Sensor / Ignition Pickup

There are two ways of getting engine RPM and crank angle information to the computer:

1) The most common method is for **Fuel only** control where an original distributor determines ignition timing and spark distribution. The signal is taken from the negative side of the coil. This is the same terminal used by most tachometer installations.

2) **Computer controlled ignition** systems require a signal from a crankshaft or special distributor pickup kit. The ignition output can then be directed through a distributor or a multi-coil system.

For ease of explanation, any reference to a computer controlled ignition triggering will be referred to as crank triggering. This will encompass both physical crankshaft triggering and trigger signals derived from a cam or distributor trigger device.

The RPM information is displayed in the top left corner of the main screen and at the top of the bargraph screen (toggle by pressing the [SET] and [CLEAR] buttons). The fuel pump LED on the Hand Controller lights when a valid timing signal is received.

As a safety feature, if the engine stops for any reason the fuel pump control wire will turn the pump off. The EMC will for half of one second.

Do not use the WOLF3D to <u>power</u> the Fuel Pump, Thermo fan or any other auxiliary devices! The WOLF3D grounds one side of an external relay, see wiring diagram at the rear of this manual.

2.3 Temperature Sensing

The WOLF3D uses both the engine's Intake Air Temperature and Water Temperature to finely tune the fuel delivery to match the engine's fuel requirements. Different styles of temperature sensors are available with different threads to match most installations. Below is a list of all VDO temperature sensors compatible with the WOLF3D for Water Temperature sensing.

VDO Part Number	Thread
320 007	M14 x 1.5
320 010	M12 x 1.5
320 013	M22 x 1.5
320 014	M26 x 1.5
320 015	M20 x 1.5
320 016	1/2" - 20 UNF
320 017	3/4" - 16 UNF
320 018	Dip Stick
320 019	Dip Stick
320 021	1/8" - 27 NPTF
320 023	3/8" - 18 Dry Seal
320 025	1/2" - 14 NPTF
320 028	1/8" - 27 NPTF

Adaptors are also available to modify the sensor to suit some applications. Most often the sensor's case is the earth and so there must be a reliable earth on the sensor's body.

Do not use teflon tape unless required (because of leakage), as use may effect the connection from the sensor to the engine. This can be a problem is the engine is being used as the earth connection for the sensor.

For Air Temperature sensing the WOLF3D uses the fast response air temperature sensor supplied.

The Air Temperature supplied must be used for air temperature sensing. Do not use the original air temperature sensor on the engines intake manifold. For Water Temperature sensing use the temperature sensor supplied, or one of the VDO parts listed above. Do not use the engines original water temperature sensor. If the incorrect temperature sensor is used, the fuelling calibration determined from the temperature sensors will be incorrect.

2.3.1 Water Temperature Sensor

The computer uses the Water Temperature Sensor to increase the amount of fuel delivered to the engine when the engine is cold just as a choke does on a carburetor. The carburetor also increases the engine speed while the choke is on by increasing the air flow to the engine. The engine speed will not increase as much using extra fuel only. A mechanical air by-pass must be used if a higher engine-cold idle is required.

2.3.2 Air Temperature Sensor

The Air Temperature Sensor is used to adjust the fuel delivery as the intake air temperature changes. Air is less dense at higher temperatures and so less fuel is required for the same volume of air.

NOTE: The MAP Sensor or Throttle Position Sensor, and the RPM tell the EMC which fuel and Ignition Map point to use. The Air Temperature, Water Temperature and Throttle Position tell the EMC how much fuel to add or subtract for any given conditions.

2.4 Oxygen Sensor

Most factory EFI engines have an Oxygen Sensor mounted in the exhaust manifold or header pipe. The Oxygen Sensor is used by the Wolf3D to fine tune the Air-Fuel Ratio (AFR) during low LOAD conditions. This optimises the efficiency of catalytic converters in the exhaust and reduces pollution. The systems adjust the fuelling to provide a chemically correct AFR of around 14.7:1 (air:fuel). This AFR is generally too lean for high load conditions such as heavy acceleration, high speed cruising and turbo or supercharged applications.

Be careful when setting up Closed Loop Control. Follow the instructions carefully. Closed Loop Control is only useful when a catalytic converter must be used. If no catalytic converter is present, the extra time require to set up the Closed Loop Parameters is not justified.

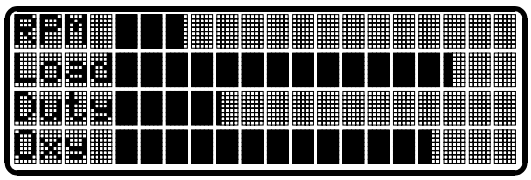
An engine run in open loop can gain an economy advantage over one in closed loop, since engines will run safely at low loads, with leaner air : fuel ratios than 14.7 : 1.

There are two OXY bargraph displays:

The first is in the lower right side of the Main screen. It is a vertical bargraph, with the top line being rich, the center stoichiometric, and the bottom line being lean.

Oxy Bargraph

The second is under the [SET] button. The right side of this bargraph is rich, the center is stoichiometric, and the left side is lean.



The OXY bar graph should be used as an approximate guide only, complementing CO and HC measurements taken from the exhaust.

Press [SET] once to move to the bargraph screen. On the bargraph the centre position would be equivalent to an Air/Fuel ratio of 14.7:1. The Oxygen Sensor is not used for closed loop operation. To return to the Main Menu press [CLR].

If [SET] is pressed twice the Data Logging menu selection will be displayed. Refer to section 16. Press [CLR] to return to the Main Menu.

The WOLF3D also supports Oxy Logging. Refer to section 16.2

If [SET] is pressed three times, the screen will display the Memory Cartridge Menu selection. To return to the Main Menu press [CLR].

2.5 Outputs

2.5.1 Injector Outputs

The Wolf3D has 5 injector outputs, 4 primary, and 1 secondary. These outputs are used to drive electronic fuel injectors only. The injector drivers are Peek and Hold type. This means that the driver opens the injector with a 'Peek' current of 4 amps. Once the injector is open, the driver 'Holds' the injector open with 1 amp of current. This allows the Wolf3D to drive many different types of injectors without the nee for external injector resistor packs. The minimum impedance (resistance) any output can drive is 1.2 Ohms. If an impedance of less than 1.2 Ohms is placed on one injector output, the driver may go into thermal shut down. This is a self protection system within the injector drivers electronics that stops any thermal damage to the injector driver caused by overloading the injector output of the Wolf3D.

2.5.2 Ignition Outputs

The 4 ignition outputs of the Wolf3d can be used to drive almost any type of coil igniter. There are many scenarios available to you when it comes to setting up the ignition outputs of the Wolf3D.

2.5.3 Auxiliary Output

The Auxiliary output can be used either as an idle speed control output, or as a switchable output. The switch point can be based on RPM, Load, Air Temp, Water Temp, Auxiliary Voltage Input, Oxy Value, Tpos, or it can be used as a map switch function, allowing you to use an external switch to swap between the internal and external fuel and ignition maps.

2.5.4 Turbo Timer

When connected to the optional WT01 turbo timer, the Wolf controls the time the engine is allowed to idle down. This can be easily overridden by pressing any key on the Hand Controller.

2.5.5 Thermo Fan

You can dial in the temperature you wish the thermo fan to operate at. The water temp must drop 3 Degrees Celsius below this user set temperature before the thermo fan will turn off.

2.5.6 Fuel Pump Output

The fuel pump output controls when the fuel pump(s) operate. They are primed for ½ a second when the Wolf3d is powered up. From then on they only operate when the Wolf3D get an input trigger. This safety feature will ensure no fuel pumps operate while the engine is stopped. This can be very important in an accident situation.

3. Installation (Fuel System)

3.1 Prior to Installation

Before installing the EMC there are several items that should be installed and checked. These are:
EFI Fuel Pump
High Pressure EFI Fuel Filter
Correct Fuel Line size and pressure rating
Injector Flow Rates and Impedance (important for custom injector installations)
Fuel Pressure Regulator
Good Battery Connections
Good Earth Connections to both the Engine Block and the Cylinder Head.

If the engine's original ignition system is being used and any components look to be in less than ideal condition it would be wise to replace them, for example; ignition leads, rotor button, distributor cap, points, and sparkplugs. Any original electrical connections that look less than satisfactory should be cut and replaced with new connectors. If these items are faulty they will make the installation and troubleshooting more difficult than it should be.

It is vital that the engine block is properly earthed specifically so current flowing through both the starter motor and the alternator is directed to the vehicles chassis, **not** through the EMC. If there is a voltage drop between the engine and the chassis, many problems can occur. To measure the voltage drop between the engine and the chassis, start the engine and use a volt meter to measure between the alternator housing and the chassis at a good earth. If there is more than 0.5Volts between the alternator housing and the chassis additional earth straps should be run from the engine to the chassis.

3.2 Fuel Pump and Injectors

FUEL PUMP

An EFI fuel pump must be used. EFI Fuel Pumps flow a large volume of fuel at very high pressure, up to 80 PSI, (5 Bar, 500 kPa) delivery pressure, or much higher restricted outlet pressure. The pump should be mounted as close to the fuel tank as possible. **DO NOT RUN THE FUEL PUMP DRY!** It may destroy the pump and can also be very dangerous. Since fuel is use to lubricate the internals of the fuel pump it should be primed by filling it with fuel before connecting the inlet and outlet fuel lines.

The WOLF3D fuel pump output grounds the coil side of the external fuel pump relay (refer to wiring diagram at the rear of this manual). Do not connect +12V to the fuel pump output on the WOLF3D, as this will damage the unit.

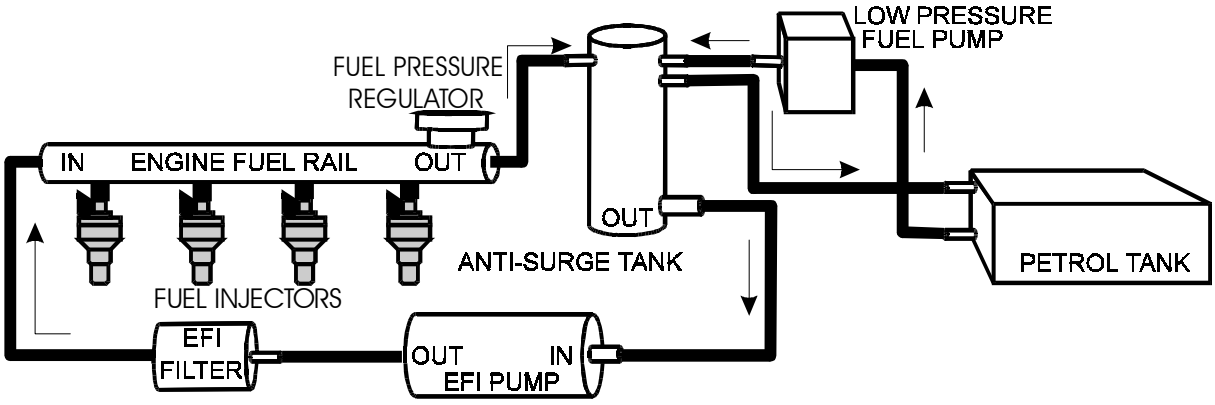
The Fuel Pump must be driven by a relay, not directly from the WOLF3D.

Once an EFI fuel pump has been run, the fuel lines on the high pressure side should not be disconnected until the fuel pressure has reduced. Wait at least 5 minutes before preceding.

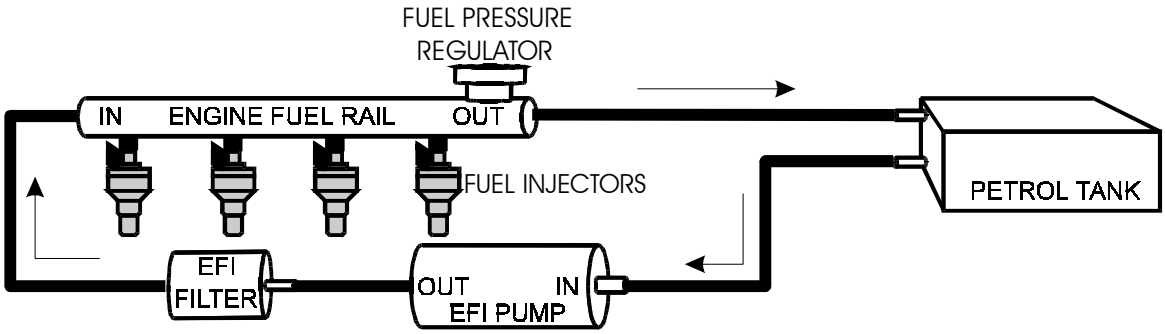
All rubber type fuel lines should be rated at fuel injection line pressure. Get advice from an AEM distributor if there is any doubt about the type of fuel line to use. Only good quality hose clamps should be used. Do not use spring clip type hose clamps as seen on many carburetted engine installations. Make sure all rubber fuel lines under the car are also replaced with high pressure rubber fuel lines since these are the most neglected of all fuel lines in the car since they can't be seen. If the car does not have a fuel return line, a return line must be installed.

Larger diameter fuel lines may have to be used if the original lines are less than 8mm or 5/16". For a high output turbo installation, fuel lines as large as 10mm or 3/8" should be used with 8mm (5/16") return lines. Fuel lines run under a vehicle, or in a position where they may sustain any damage should be of steel construction, not rubber. Also make sure the fuel tank has a reasonable amount of fuel in it before turning on the pump, since fuel delivery to both the pump and the injectors is very important. Any air picked up by the pump can quite easily be transferred to the injectors, causing the engine to stutter as well as being dangerous for the fuel pump. This is because the fuel flowing down the fuel line and through the fuel rail is under high pressure, up to 80 PSI (5 Bar, 500 kPa), depending on the fuel regulator relief pressure. There is no chance for any air bubbles to get out of the system. Therefore whatever the fuel pump picks up goes all the way through the system. This is different to a carbureted engine where the fuel sits in the carburettor at atmospheric pressure and any air bubbles can float to the top of the fuel bowl, thereby removing them from the fuel.

To stop bubbles from entering the system, cars equipped with EFI have tanks containing more baffles than for those fitted with carburettors. If it is found that fuel pickup is a problem then an intermediate or anti-surge tank may need to be installed between the main tank and the EFI pump. To determine if fuel pickup is a problem, first run the car with the fuel level very low, note how the car runs especially out of corners and under hard acceleration and braking. Then fill the tank at least half way. Repeat the tests at the same place and compare how the car feels remembering that it has a greater weight because of the extra fuel. If the car feels smoother and more responsive with the higher fuel level then there may be a fuel pickup problem. For more information contact the nearest AEM Distributor.



FUEL SYSTEM USING ANTI-SURGE TANK



FUEL SYSTEM WITHOUT ANTI-SURGE TANK

NOTE: A fuel delivery problem may not show up on a dyno test because it may only occur while the car is either accelerating, braking, or cornering. Another way to check it is to have a good quality fast reacting electric fuel pressure gauge mounted in the cabin to see if the fuel pressure changes under various driving conditions. A transitory fuel surge problem may not show up with this test.

INJECTORS

It is very important that all injectors on each primary injection bank have the same impedance and flow rate. This will assure each injector delivers the same amount of fuel to each cylinder/rotor. If injectors with different impedances are used on the primary injector banks some cylinders/rotors may run lean, while others may run rich.

Injectors used on the staged injector bank must be of the same impedance, but can be different to the injectors used on the primary injector banks.

The WOLF3D Injector outputs ground the injector solenoid (refer to the wiring diagram at the rear of this manual). Do not apply +12V directly to any injector outputs as this will result in damage to the WOLF3D.

Each piston / rotor must have its injector(s) equal in both flow rates and impedance to assure correct fuelling throughout the engine. It is recommended that the injectors are cleaned and flow tested.

To measure the injector impedance:

Use an Ohm meter across the injectors electrical connection pins. The reading should be in the range of 1.1 to 16 Ohms. If the value is outside these limits, consult an AEM Distributor.

4. Installing the Wiring Loom

The WOLF3D comes with a complete wiring loom that has the main 36 pin plug factory assembled. All other connectors are supplied with the Wiring Kit to make installation of the WOLF3D Wiring Loom as simple as possible.

There are three groups of wire in the loom in three sizes, with multi-coloured cores for easy identification.

The Heavy group of wire is	(4mm)	7 core
The Medium group of wire is	(3mm)	5 core
The Lightest group of wire is	(2mm)	7 core

For ease of instructions, a YELLOW wire of 3mm diameter is shown as YELLOW 3. The Main wiring diagrams are at the rear of this manual.

There are also three Option plugs for Turbo timer, Input trigger and Ignition trigger outputs.

Advanced Engine Management recommend all terminations are **crimped and then soldered** for maximum reliability of all connections.

Wires should not be extended by twisting or joining extra lengths, but should be replaced with wire of the correct length. Always try to have the minimum number of connections in the wiring loom of for the EMC, as fewer connections assures maximum reliability.

Keep wires away from heat such as exhaust system, engine block, hot water pipes, etc. Use heat resistant sleeving where necessary. Do not place wires under tension.

Do not run any signal wires near spark plug leads or the alternator charge wire.

The Wiring Diagram colour code and wire size should be strictly followed to assure no overloading of any electrical circuits.

The external fuse supplied with the WOLF3D EMC is of 1 amp capacity. The fuse **must not** be replaced with fuse of greater capacity. Doing so may result in component failure and will void all warranties.

Holes in metal panels through which electrical wires pass must be sleeved with grommets.

The Wiring Loom must be securely mounted to the vehicle to assure no damage will occur to it from heat or rotating engine parts.

To install extra wires into the 36 pin plug on the WOLF3D:

Disconnect the wiring harness plug from the WOLF3D.
Carefully remove the white anti-backout plate from the 36 pin plug.
Remove the appropriate waterproofing plugs from the rear of the 36 pin plug.
Insert the crimped and soldered gold plated pins into the 36 pin plug.
Secure the new cable to the original wiring harness so no load is placed on the new cable.
Reinstall the white anti-backout plate.
Plug the 36 pin plug into the WOLF3D.

To install wires into injector plugs:

Remove required amount of black insulation from the loom.
Push white seal onto the appropriate wire with the small end facing the end of the wire.
Strip the coloured insulation from the end of the wire.
Crimp and solder the injector pins onto the wire.
Push the pin into the back of the injector plug.
Slide the white seal down into the relief hole in the rear of the injector plug.

5. Installation (Sensors)

5.1 Input Trigger Installation

vo Input Trigger modes are ***Single Pulse Mode*** and ***Dual Pulse Mode***.

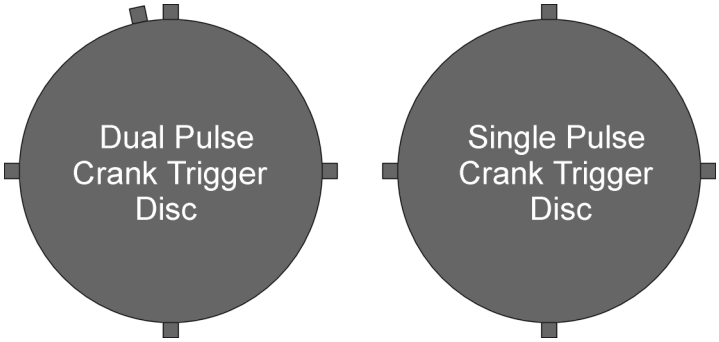
Single Pulse Mode refers to the cam, crank or distributor sensor having equally spaced pulses. This information only tells the Wolf how fast the engine is rotating.

Dual Pulse Mode infers two pulses close together. The Dual Pulse system tells the Wolf3D where Top Dead Centre is. This system tells the Wolf the engine speed, and the engine position via the two close pulses.

A distributor can be used to distribute the spark whichever mode you choose.

For Multi-coil applications a Dual Pulse system must be used.

Note the difference between the two discs. The Dual Pulse Trigger Disc has 2 (Dual) teeth at the top of the disc. The dual teeth tell the Wolf3D where the crank is because the Wolf3d can distinguish between the individual teeth and the dual teeth at the top of the disc. The Single Pulse Crank Trigger Disc has no reference information. The Wolf3D cannot tell the difference between any of the teeth since they are all equally spaced.



The 3 main input trigger types are explained in detail over the next page. You must choose the type of installation you wish to use before you proceed past the following section.

5.1.1 Original Distributor used for ignition timing and spark distribution.

When using the engine's original distributor for both ignition timing and spark distribution, only one wire has to be connected to the computer for it to determine the engine's RPM. Simply attach the YELLOW 3 wire to the negative side of the ignition coil. This is the same terminal as the distributor uses to discharge the coil and to trigger a standard tachometer. Do not run the YELLOW 3 wire parallel or near to the high tension ignition leads, as the high tension leads may cause Electro-Magnetic Interference giving the WOLF3D inaccurate RPM information. See the Main Wiring Diagram at the rear of this manual. Every time the coil fires a signal is sent to the computer and the computer calculates the RPM and injection timing.

5.1.2 Crank or Distributor Triggered Ignition and the Original distributor used for spark distribution only.

To utilise Crank Triggered Ignition, an AEM Crank Trigger Kit, or possibly an modified original crank trigger must be used. For this installation the engines original distributor has to be locked in one position.

If you prefer to use your distributor as the input trigger device, it will have to be modified to suit the Wolf3Ds' input trigger requirements.

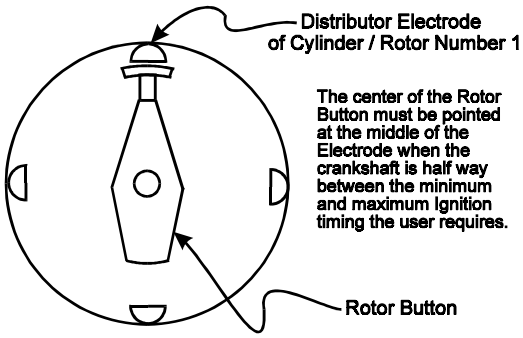
5.1.2.1 Rotor Button Alignment

The distributor must be removed from the engine so the distributor shaft can be welded up. This prevents the distributor from performing any centrifugal advance. The two halves of the shaft can have any orientation to each other. The only important part of the process is that there be no movement in the shaft once it is welded up.

The distributor must be set up in such a way as to allow as wide as possible an Ignition Timing range. This is achieved by positioning the rotor button pointing directly at the Cylinder / Rotor 1 Electrode in the distributor cap while the crankshaft is positioned at 22 degrees Before Top Dead Centre. The Wolf3D has an ignition advance range of 0 – 45 degrees, so this position puts the rotor button right in the middle of its range.

If the distributor is not set up correctly, the spark may run off the end of the rotor button causing ignition problems.

The diagram below shows an example of a four cylinder distributor set up. The same theory applies to Rotary, 4 cylinder, 6 cylinder and 8 cylinder applications.



Once the distributor is locked, (ie. no mechanical or vacuum advance) in one position, the WOLF3D can take over the Ignition Timing duties.

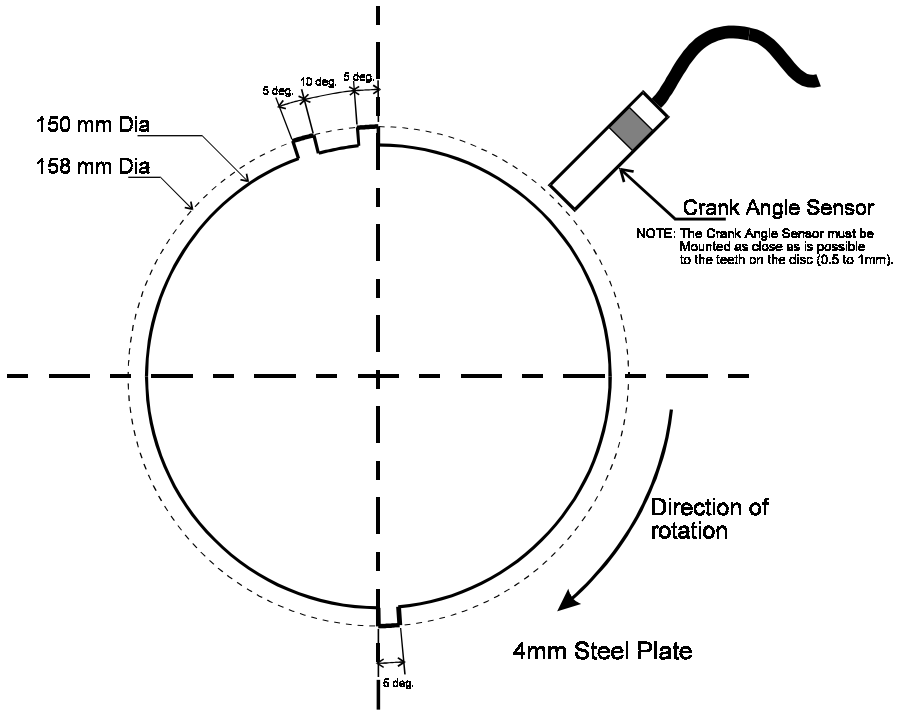
Step by step rotor button alignment

1. **Put the Crankshaft at 22 degrees Before Top Dead Centre**
2. **Mark on the distributor housing, exactly where the electrode for cylinder 1 is**
3. **Put the distributor in the distributor hole and by moving the housing, align the rotor button with the mark for cylinder number 1 electrode**
4. **Once the rotor button is pointing at the electrode, tighten down the distributor housing**

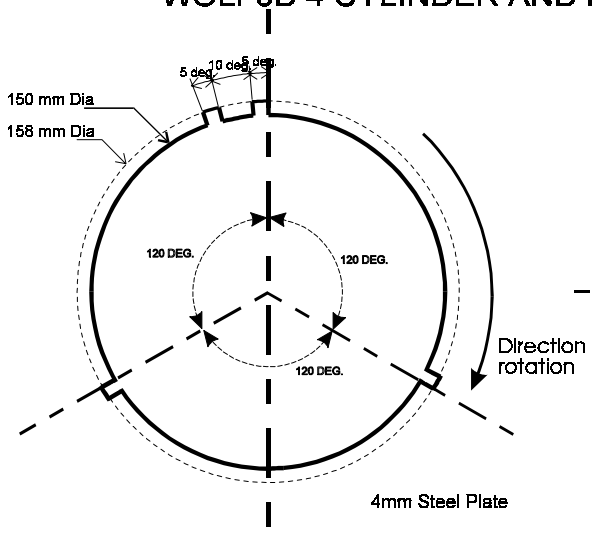
The distributor housing must NOT be moved again. If you are using the pickup inside the distributor as an input trigger for the Wolf3D, you must move the sensor within the housing to set up the ignition advance, do NOT move the housing to modify the advance, as the rotor button alignment changed, making the chances for misfire quite high.

5.1.3 Crank or Cam Triggered and Multi-Coil Ignition.

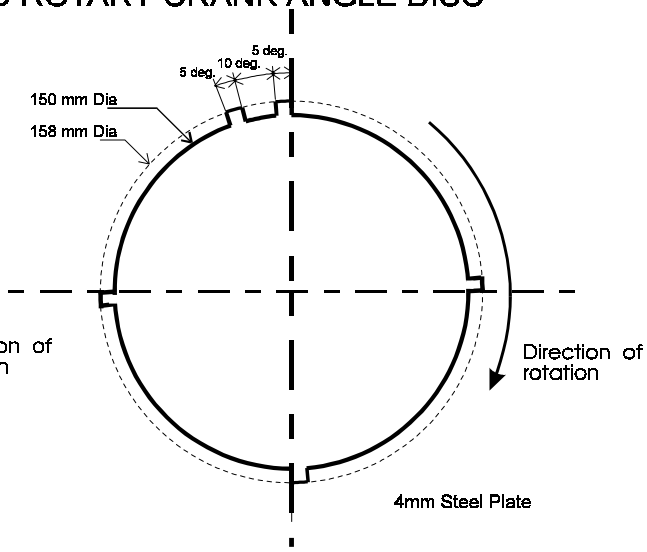
When using Crank or Cam Triggered and Multi-Coil Ignition the engine's original distributor may be removed completely. Most applications will require a disc as shown below to be mounted on the front of the crankshaft, while some may use modified Original Equipment Manufacturers (OEM) crank or cam angle sensors. Refer to Section 15.2 for more information on OEM crank and cam angle sensors.



WOLF3D 4 CYLINDER AND ROTARY CRANK ANGLE DISC



WOLF3D 6 CYLINDER CRANK ANGLE DISC



WOLF3D 8 CYLINDER CRANK ANGLE DISC

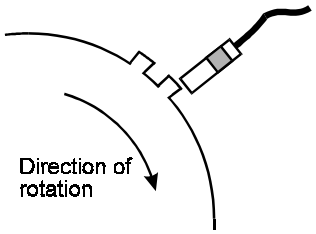
The discs above all have two teeth very close together, one at 12, and one at 11 o'clock. Because of this, they are designed to run in Dual Pulse Mode. For cam angle sensing, there has to be exactly twice as many teeth around the disc, since in a cam angle sensor, the disc is spinning at exactly half crank speed.

The Crank Angle Disc does not have to be exactly 158 mm in diameter. The tooth angles ,(5 and 10 deg.) must be maintained, with a constant 4mm tooth height a priority. Any mounting bolts should not be within 25mm of the top of the teeth as with any component that may disturb the magnetic field around the Crank Angle Pickup causing false Input Triggering.

The disc must be centred and run true, as any runout may cause false Input Triggering.

The position of the crankshaft or cam trigger disc in relation to the crank angle sensor is very important. The disc has one set of double teeth and 1, 2, or 3 single teeth, depending on the application. The first of the double teeth must pass the crank angle sensor 60 degrees top dead centre of cylinder / rotor number 1. After the double teeth pass the sensor, the WOLF3D delays the signal until the appropriate crank angle has been reached. The WOLF3D then fires the ignition coil(s) at the user defined advance.

The diagram below shows the position of the crank angle sensor and crank trigger disc at 60 degrees before top dead centre.



The crank angle sensor must see the leading edge of the first of the double teeth when the crank is 60 degrees before Top Dead Centre.

5.2 AEM Water Temperature Sensor Installation

The Water Temperature Sensor supplied with the WOLF3D should be installed in a position near the original water temperature sensor for the water temperature gauge if possible. It is not advisable to remove the original water temperature sensor controlling the dashboard mounted gauge since monitoring the engine's water temperature is vitally important for engine life. The Water Temperature is used to turn on a warning Light, on the Hand Controller and to turn on an electric fan, at a user defined temperature.

The WOLF3D grounds the thermo fan's relay solenoid (refer to the wiring diagram at the rear of this manual). Do not connect +12V directly to the thermo fan output on the WOLF3D as damage to the unit will result.

The Water Temperature Sensor is connected to the EMC via the WHITE 2 wire. Use the correct clip and the black plastic casing. Crimp the connector to the wire before soldering the wire to the connector. Push the connector into the black plastic casing and clip the connector onto the Water Temperature Sensor.

Do not use teflon tape on the sensor thread unless a leak occurs, as the sensor case must be properly grounded to ensure accurate water temperature metering.

5.3 AEM Air Temperature Sensor Installation

The installation location for the Air Temperature Sensor is dependent on the type of intake system being used on the engine.

If the intake utilises a cold air box or a type of air ram scoop system the sensor may be mounted within the air box or anywhere along the intake ducting. If the intake system is drawing air from the engine bay the sensor should be mounted within the engine bay on the intake side of the engine. Another option is to mount the sensor in the plenum chamber if the engine has one.

If the engine has an intercooler, the sensor should be mounted after the intercooler to accurately determine the intake charge temperature.

The Air Temperature Sensor is connected to the EMC via the YELLOW 2 and BLUE 2 wires. Push the wires through from the rear of the connector and crimp and solder the wires to each pin. Pull the wires back into the plastic casing until the pins clip in. Clip the connector onto the Air Temperature Sensor.

5.4 Throttle Position Sensor Installation

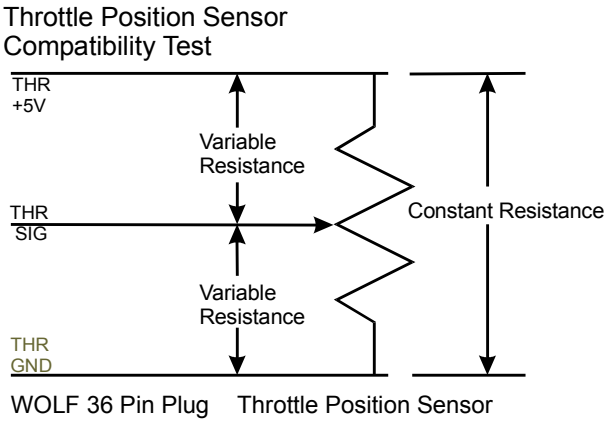
If the Throttle Position Sensor is being used for Load sensing it must be securely mounted and once calibrated, locked into position. If the sensor's physical position changes, both the Fuel and Ignition maps will need recalibration.

5.4.1 Original Equipment Throttle Position Sensor

It must be determined if the engine's original Throttle Position Sensor is compatible with the WOLF3D. Some experience using an ohm meter is required to ensure correct determination of compatibility.

There must be two terminals on the Throttle Position Sensor that remain a constant resistance somewhere between 2,000 Ohms and 20,000 Ohms while the sensor is rotated. These terminals are wired to the THR +5 and THR GND.

There must be an even variable resistance between a third terminal and both the THR +5 and the THR GND as shown in the diagram below.



NOTE:
There must be a higher resistance between the THR SIG terminal and the THR +5 terminal at closed throttle than at open throttle. If this is not the case, swap the THR GND and THR +5 terminals on the sensor and retest the throttle position sensor.

The TPS must be installed with **closed throttle** giving the **lowest** possible LOAD value. With some throttle position sensors, this value may be as high as 30.

Many Original Equipment Throttle Position Sensors operate as a switch rather than a variable resistance. This type of sensor is **not** compatible with the WOLF3D Engine Management Computer.

Refer to the TPos electrical calibration section below for final Throttle Position calibration instructions.

If the TPS Sensor is to be used for determining both the **LOAD and the Acceleration Enrichment**, an AEM Throttle Position Sensor, TPS1 **must** be used. This is extremely important to the functionality of the Map look-up for fuel and ignition values.

5.4.2 AEM TPS1 Throttle Position Sensor

The mechanical installation of the TPS1 must be carried out in such a way as to place no load on either the butterfly shaft or the sensor itself. The shaft must be machined into a “D” shape to allow the TPS1 to lock into the shaft without any binding. See the diagram below for shaft dimensions. The sensor is securely mounted to a bracket on the engine which holds the case of the TPS1 against the rotational force placed on the shaft by the throttle shaft. The bracket should be ridged enough to in no way allow the sensor to shift in relation to the throttle body. Once the sensor’s location is set it must remain in position to maintain the engine’s state of tune.

TPS1 to EMC connections:

TPS1	black	-	BLACK 2 THR GND
	green	-	GREEN 2 THR SIG
	red	-	RED 2 THR +5V

See the main wiring diagram for wiring details.

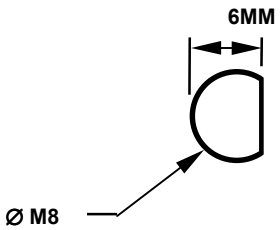


Figure X. Throttle Shaft End Profile for use with TPS1.

The Sensor must be located in such a way as to have a smooth increase in TPOS value when the throttle is opened to assure accurate throttle mapping.

Refer to Section 15.1 for more information on the TPS1.

Closed throttle must give the **lowest** LOAD value possible.

Throttle bodies for many applications are available with an appropriately machined throttle shaft.

5.4.3 Electrical Calibration of TPS

At full throttle the EMC must show a LOAD of 98. To achieve this value, the TPOS Calibration potentiometer (pot) may have to be adjusted.

NOTE: The TPOS Calibration Pot is located inside the EMC. Refer to Section 4 for details on Calibration Pot position.

To adjust the LOAD value

Fully open the throttle
Turn the pot clockwise to increase the value
Turn the pot anti-clockwise to decrease the value

The Pot is delicate and should be used with care.

The pot will only be needed to turned anti-clockwise, if the full throttle value is above 98; eg 04 (104).

To optimise the TPS for LOAD sensing, the widest possible range is desired. To achieve this, the TPS may have to be mechanically readjusted in relation to the throttle shaft. The TPOS Calibration Pot will then have to be trimmed to bring the Wide Open Throttle (WOT) LOAD value back to 98.

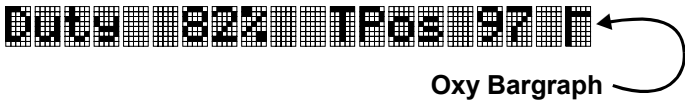
WOT TPOS 98

Continuously variable

Closed Throttle TPOS as low as possible

5.5 Oxygen Sensor Installation

If an Oxygen Sensor of the heated type, (it will have three or four wires), is installed, it can be mounted at the collector to gain an average of all cylinders exhaust oxygen content. If the sensor used is of the non-heated type, (a single or dual wire from the top of the sensor), it may need to be installed closer to the engine. This may be a compromise since the sensor may have to be mounted where the exhaust gas of only one or two cylinders will flow. The non-heated type requires the hot gases to heat it up before it will show an accurate oxygen content. It may take up to 3 or 4 minutes when using a non-heated type sensor, to heat the Oxygen Sensor to the required temperature (300 degrees Celsius). The exhaust Oxygen value is shown on the bargraph screen and in the lower right corner of the Main Screen.



Oxy Bargraph

For wiring details see the Wiring Diagram at the rear of this manual.

6. Installation (Outputs)

The Wolf3D has many output functions. The main ones are the injection and ignition outputs. For most of this chapter you will learn about the factors you have to take into account when wiring up the Wolf3D. These include maximum loads the Wolf3D can drive and some specific examples of injector and ignition output wiring.

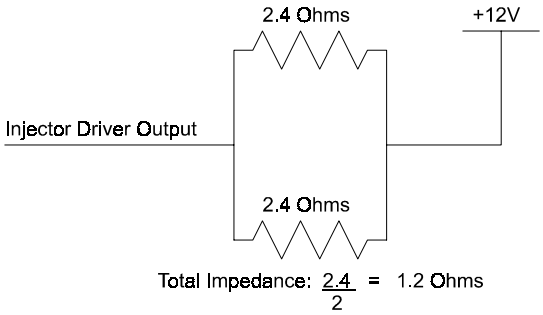
6.1 Injector Outputs

The injector drivers used in the Wolf3D are of the 'peak and hold' type. This refers to the current flow through the injector driver. The driver allows the injector to pull 4 amps through it to open the injector, then it limits the injector to 1 amp to keep the injector open. This type of driver allows many different types of injectors to be used because it is self regulating.

The only time this becomes a problem is when very low impedance injectors are used. Low impedance means the injectors are approximating a straight piece of wire, and are almost 'shorting out' the injector driver. This is putting a high load on the injector driver. The driver has to try and limit the current flowing through itself. This generates a great deal of heat. We use injector drivers with thermal overload protection. They automatically switch off until the internal temperature decreases to a normal level. This results in the engine running erratically.

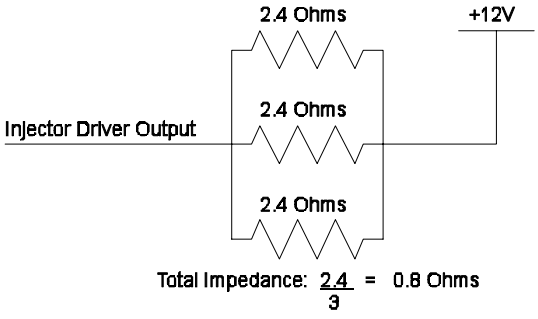
To ensure this problem never arrises, the minimum impedance you should place across any injector output of the Wolf3D is 1.2 Ohms. To achieve this, it important to know what impedance your injectors are. You can measure them with a good quality multi-meter. Most multi-meters are not very accurate at very low impedances, so if you are in doubt, find a high quality meter to us, to talk to the distributor where you bought your Wolf3D.

In the first example there are two 2.4 Ohm injectors in parallel on an injector driver output of the Wolf3D. Since they are in parallel we follow the formula below the example to end up with 1.2 Ohms. Since 1.2 Ohms is equal to the minimum impedance of 1.2 Ohms, this injector configuration will work perfectly.

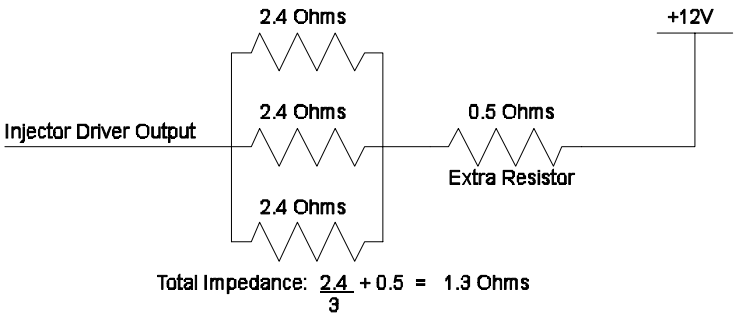


The second example on the other hand shows an impedance of 0.8 Ohms on the injector driver output of the Wolf3D. This will definitely cause the injector driver to go into thermal shutdown. Look to the next example to find out how to overcome this problem.

This injector combination cannot be used.



The third example shows a way of getting around the impedance problem by adding a resistor in series with the three injectors. This way the injector driver output will see a total of 1.3 Ohms which is 0.1 Ohms above the minimum of 1.2 Ohms.



For your specific application, replace the 1.2 Ohms impedance values used in the examples above with the impedance values that you have.

If your injectors are 12.2 Ohms, and you have three in parallel, the equation is simply:

$$\frac{12.2}{3} = 4.07 \text{ Ohms}$$

This is above the 1.2 Ohms minimum impedance, and therefore will not cause a problem to the injector driver output of the Wolf3D.

In the table below the Cylinder Numbers refer to the cylinders in firing order. That is, 1 means the first cylinder in the firing order, and 5 means the 5th cylinder in the firing order.

Engine Type	Injector Bank 1A	Injector Bank 2A	Injector Bank 1B	Injector Bank 2B	Staged Injection Output
2 Cylinder	Cylinder 1	Cylinder 2			If required
3 Cylinder	Cylinder 1	Cylinder 2	Cylinder 3		If required
4 Cylinder	Cylinder 1	Cylinder 2	Cylinder 3	Cylinder 4	If required
6 Cylinder	Cylinders 1,4	Cylinders 2,5	Cylinders 3,6		If required
8 Cylinder	Cylinders 1,5	Cylinders 2,6	Cylinders 3,7	Cylinders 4,8	If required
12 Cylinder	Cylinders 1,5,9	Cylinders 2,6,10	Cylinders 3,7,11	Cylinders 4,8,12	If required
2 Rotor	Rotor 1	Rotor 2			If required
3 Rotor	Rotor 1	Rotor 2	Rotor 3		If required

6.2 Ignition Outputs

The Wolf3D has 4 ignition outputs. There are many ways to configure these outputs. This is dependant on your specific application. The following outputs are from the WOLF3D **IGN-1** cable, supplied with the WOLF3D.

OUTPUT NAME	WOLF3D PINOUT	IGN-1 COLOUR
IGN GND	31	BLUE / SHIELD
IGN1	32	RED
IGN2	33	YELLOW
IGN3	34	GREY
IGN4	16	GREEN
TACH. OUT	17	VIOLET

For single coil applications, the four ignition outputs of the Wolf3D will function the same. That is, the four outputs will charge and fire coils at the same time. To simplify single coil applications, use IGN-1 as the output.

For single coil systems used for piston engines the following outputs are used from the IGN-1 cable:

IGN GND - ignition ground
IGN1 - to igniter signal
In Distributor mode, all ignition outputs pulse at the same time.
This applies to all piston engine configurations.

For Multi-coil systems the following outputs are used from the IGN-1 cable:

6.2.1 Standard Wolf Rotary Mode

Multi Coil (1 Dual 2 Single)

IGN1	-	RED	Trailing Coil 1
IGN2	-	YELLOW	Leading Coil (1 & 2)
IGN3	-	GREY	Trailing Coil 2
IGN4	-	GREEN	Not Used

Distributor

IGN1	-	RED	Not Used
IGN2	-	YELLOW	Leading Coil (1 & 2)
IGN3	-	GREY	Not Used
IGN4	-	GREEN	Trailing Coil (1 & 2)

6.2.2 Piston Engines

<u>Four Cylinder:</u>

IGN1	-	2nd and Opposed
IGN2	-	1st and Opposed
IGN3	-	2nd and Opposed
IGN4	-	1st and Opposed

<u>Six Cylinder:</u>

IGN1	-	2nd and Opposed
IGN2	-	3rd and Opposed
IGN3	-	1st and Opposed

Eight Cylinder:

IGN1 - 2nd and Opposed
IGN2 - 3rd and Opposed
IGN3 - 4th and Opposed
IGN4 - 1st and Opposed

It is important to use only one ignition coil off each ignition igniter.

MAZDA:

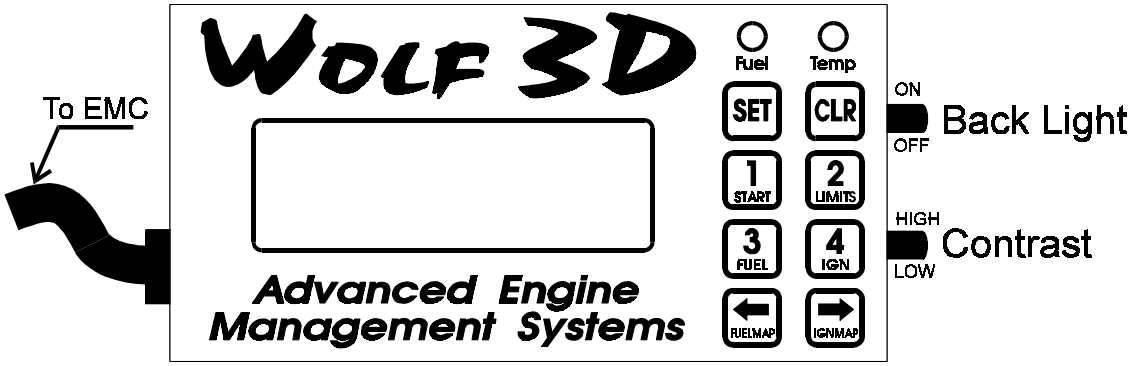
The IGN-1 output cable colour codes:

IGN-1 COLOUR -	FUNCTION		MAZDA TERMINATION	
IGN GND -	GND	-	CHASSIS	
RED -	TRAILING TRIGGER	-	RED	(4 PIN PLUG)
GREY -	TRAILING SELECT	-	WHITE	(4 PIN PLUG)
	NOT CONNECTED TO WOLF3D	-	GREY +12V	(4 PIN PLUG)
	TACHO OUTPUT TO ORIGINAL TACHO	-	YELLOW	(4 PIN PLUG)
YELLOW -	LEADING TRIGGER	-	RED	(2 PIN PLUG)

ELECTRONIC DISTRIBUTOR: The Mazda electronic distributor from Series 2 & 3 RX7 and 12A turbo. A changeover distributor is available from your AEM distributor. The WOLF3D does not only the leading ignition timing, but also the trailing ignition timing. Series 1 RX7 can be modified to suit, consult your AEM distributor.

SERIES 4 MULTICOIL: The Mazda multicoil and systems can be used in conjunction with the WOLF3D. The Mazda trailing coil pack uses a trigger input to time the trailing coils plus a select line to select which trailing coil is being fired. There is a four pin plug and a two pin plug. The four pin plug is for the trailing ignition coils and the 2 pin plug is for the leading coil. Use the tacho output of the Wolf3D to drive the cars original tacho.

7. Engine Management Computer (EMC)

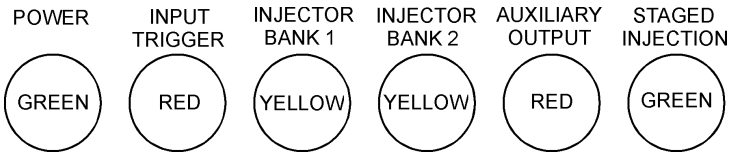


WOLF3D HAND CONTROLLER

The AEM WOLF3D Engine Management Computer is menu driven making it very easy for those unfamiliar with fuel injection to follow. It is very easy to get a 'dry' WOLF3D tuned to start and run an engine in a short time. This is possible through a three-way mapping procedure, using LOAD Bands, RPM Bands and Individual Points. The WOLF3D has a Fuel Map resolution of 16 RPM points * 8 LOAD points, a total of 256 Fuel and Ignition Map points. The system then interpolates between these points giving an extremely fine graduation to the fuel curve. Setting all of the Map points individually is not necessary to start and run the engine. Band adjustment allows the user to raise or lower whole LOAD or RPM Bands. Individual Map point adjustment is then used to fine tune the system where required. Adjusting only the Load Bands of which there are 8, and the RPM Bands of which there are 16, allow the engine to start and run. There many pieces of information including sensor inputs and user parameters the WOLF3D uses to determine the correct amount of fuel to inject and the timing of Ignition spark.

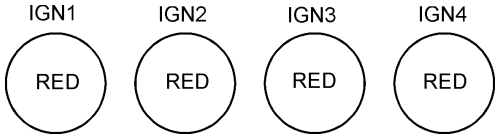
Note: The EMC will not lose the Fuel and Ignition Maps, or any other user set information if the main power is disconnected from the unit.

The WOLF3D has many diagnostic features which are not limited to the Hand Controller. On the side of the EMC next to the Memory Cartridge plug are six Light Emitting Diodes (LED's) as shown below. With these LED's, it is very easy to see whether the EMC is receiving Power and an Input Trigger, as well as the output functions of the three Injector banks, 1, 2, Staged Injection and the Ignition Output Trigger.



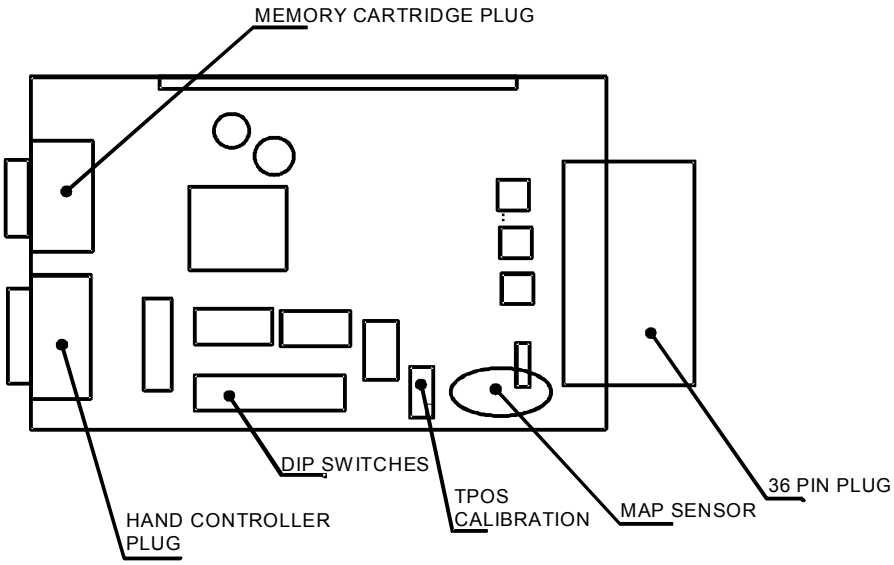
LED Diagnostic Panel

The WOLF3D also has four ignition output channels. The ignition outputs can be used for ignition systems ranging from a single coil on a distributor system, to multi-coil on a rotary or V8.



Before connecting power to the EMC the installer must assure the EMC's Hardware setup is correct for the intended installation. This is achieved using the 12 DIP Switches mounted within the WOLF3D at the side of the EMC's circuit board.

To remove the Lid of the EMC, unscrew the two countersunk screws in each side of the box. Carefully slide the Lid vertically upwards, being sure not to place any load on the internal vacuum line. See below.



WOLF3D ENGINE MANAGEMENT COMPUTER

7.1 Brief Menu Description

The Wolf3D uses a menu system to select the function you wish to see or modify. If you press any button (while on the main screen) you will switch to a menu of which you have four options. Buttons 1 to 4 have another set of menus hidden under the [->] button. Use the [->] and [<-] buttons to toggle between the two menu layers.

7.2 DIP Switch Selection

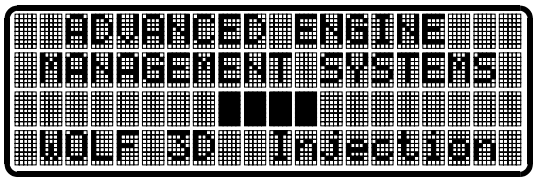
The DIP Switch selection tables below allow the installer to set up the WOLF3D's hardware requirements.

1. Cylinder Select	4 Stroke	DIP Switch 1	DIP Switch 2	Jumper 1 (J1)
	Rotary	OFF	OFF	OFF
	4 Cylinder 2 Ignition firings per revolution	ON	OFF	OFF
	3 Rotor / 6 Cylinder 3 Ignition firings per revolution	OFF	ON	OFF
	8 Cylinder 4 Ignition firings per revolution	ON	ON	OFF
	12 Cylinder 6 Ignition firings per revolution	OFF	ON	ON
	2 Stroke	**DIP Switch 1**	**DIP Switch 2**	**Jumper 1 (J1)**
	Refer to you Wolf Distributor			
2. Input Trigger Pulse Mode	**Input Trigger Pulse Mode**	**DIP Switch 3**		
	Single Pulse	OFF		
	Dual Pulse	ON		
3. Air Temp Compensation	**Air Temp Compensation enable / disable**	**DIP Switch 4**		
	Air Temp Compensation On	ON		
	Air Temp Compensation Off	OFF		
4. Load Sensing	**Load and Acceleration Enrichment**	**DIP Switch 5**	**DIP Switch 6**	
	Tpos Load Sensing with Air Pressure Compensation	ON	ON	
	Tpos Load Sensing with no Air Pressure Compensation	ON	OFF	
	MAP Load Sensing With Tpos Acceleration Enrichment	OFF	ON	
	MAP Load Sensing With MAP Acceleration Enrichment	OFF	OFF	
5. Map Lockout	**Enable / Disable**	**DIP Switch 7**		
	Disable Map Lockout	ON		
	Enable Map Lockout	OFF		
6. Turbo Boost Level		**DIP Switch 8**		
	Normally Aspirated	OFF		
	12 PSI Maximum	OFF		
	21 PSI Maximum	ON		
7. Input Trigger Sensitivity	**Input Trigger Type**	**DIP Switch 9**		
	AEM pickup TRG02 Optical pickup Hall Effect Pickup Coil Negative	ON		
	Low Output Magnetic pickup	OFF		
8. Turbo / Normally Aspirated		**DIP Switch 10**		
	Normally Aspirated	ON		
	Turbo / Super Charged	OFF		
9. Input Pulse Type	**Single / Dual Input Pulse Mode**	**DIP Switch 11**		
	Single Pulse Mode	ON		
	Dual Pulse Mode	OFF		
10. Input Filtering	**Time Based Input Filtering**	**DIP Switch 12**		

7.3 Initial Power up

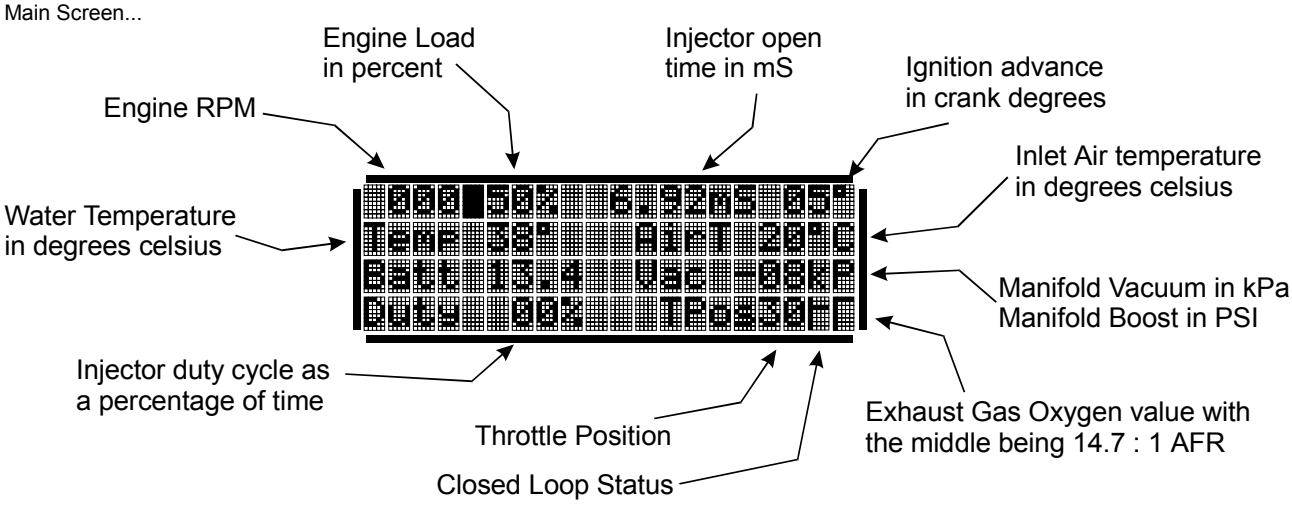
Turning power on to the EMC will bring up the Startup Message to the Hand Controller screen for 2 seconds:

Startup Screen....



Then it will revert to the Main Screen

Main Screen...



Once the computer has been powered up, check to see if all of the sensor readings are showing correct values:

Water and Air Temp.	ambient deg.C
RPM	000
LOAD	if using a MAP sensor to determine engine LOAD; approx. 94 for normally aspirated, 49 for 12 PSI max boost level, 34 for 21 PSI maximum boost level. if using Throttle Position Sensor; 98, at wide open throttle
DUTY	00%
Injection Time	approximate Cranking Fuel Rate, or 0.00FC if TPos value between 75 and 98.

If any of the above readings are not close to the required cold-start values, check the installation and wiring of the sensor concerned. See the Troubleshooting section. Now, there are several decisions to be made concerning the type of installation to be carried out. Please follow these steps for a quick and efficient installation process.

7.4 Turbo / Normally Aspirated.

DIP switch number 10 is used to configure the EMC for either Normally Aspirated or Turbo modes. It is located on the side of the EMC in the bank of DIP switches.

There are three Manifold Absolute Pressure level scales:

1) Normally Aspirated, where 93% Load is atmospheric pressure.*
2) 12 pounds boost mode, where 50% Load is atmospheric pressure.**
3) 21 pounds boost mode, where 35% Load is atmospheric pressure.**

* In normally aspirated mode 93% is used as atmospheric instead of 100% to allow for some ram charging effects of bonnet scoops etc.
** If the engine load goes above atmospheric (35% or 50%) the engine is experiencing forced induction.

See section 7.2 for DIP switch selection.

7.5 Injection Scale Adjust

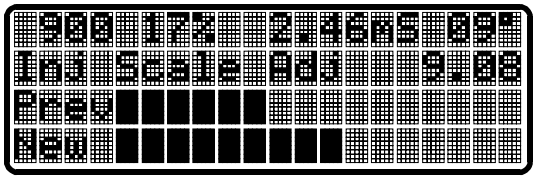
1. Select the Fuel Map button 

2. Choose menu 4 "Injection Scale Adjust" 

3. Use the left and right arrows to modify the injector scale to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

This feature determines the maximum fuel delivery time for greatest tuning resolution for the particular engine the system is being installed on. If the full scale value is too low eg. 4.00mS, and the engine needs 5.00ms of fuel, the EMC would run out of adjustment before the correct fuelling is achieved. Conversely, if the full scale value is set too high eg. 20.00mS and only 4.50mS is needed, the adjustment steps will not be as fine as they could be.



Note: One millisecond (mS) is one thousandth of a second (0.001 seconds)

To calculate the Injection Scale Adjust value required for the engine, the RPM point of maximum power must be known. Substitute this value into the equation to find the Full Scale Injection Time required.

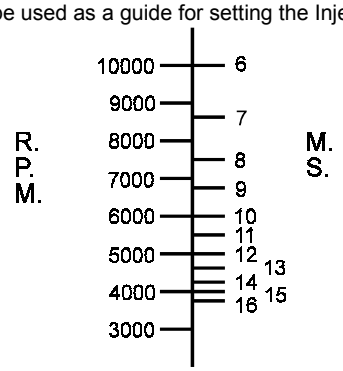
$$\frac{60}{RPM} \text{ X } 1000 = \text{x mS}$$

This value is the Injection Scale Adjust Time in milliseconds. This time represents the maximum time between injection firing at the point on the power curve when the engine requires the maximum amount of fuel. If after setting the Injection Scale Adjust time, and still there is a lack of fuel at any Map point, ie the Hand Controller reads 100% DUTY CYCLE, either the injectors used on the engine are too small, or the regulator pressure is too low.

When the Duty Cycle has exceeded 100%, a block next to the Duty Cycle value is turned on, similar to the one used for invalid RPM readings. Under normal operation this block should NEVER come on. If it is on it means the injectors are too small. The injectors should be replaced with ones that flow more fuel, or the fuel pressure can be increased until the injectors never reach 100% duty cycle.

The Injection Scale Adjust time can be tuned between 0.0 and 16.0mS.

The following table may be used as a guide for setting the Injection Scale Adjust time:



EXAMPLES: 1 – If maximum power is at 6000RPM, the Injection Scale Adjust should be set at approximately 10mS.
2 – If maximum power is at 9000RPM, the Injection Scale Adjust should be set at approximately 7mS.
3 – For maximum power at 5000RPM, the Injection Scale Adjust should be set at approximately 12mS.

Simply estimate the RPM that maximum power will occur, look across from that RPM to the mS time corresponding to that RPM. To give yourself at little leeway, adjust the Injection Scale Adjust to be a value a little greater than the mS time determined from the guide. This way, if the maximum power is at a lower RPM than you estimated, you are still able to adjust the fuelling accordingly.

To store this value press the [SET] button and the value will be stored in the computer's memory. This value will remain in the computer's memory unless the same procedure is repeated, and the value changed. To return from a parameter set menu simply press [CLR] to return to the main menu. This applies to programming all parameters while programming the WOLF3D.

If at the point of maximum power, the Injection Scale Adjust value has been reached and still more fuel is required, the vehicles fuel system is not matched to the engines fuel requirements. If this occurs and the fuel pressure or injector size is increased, the Map points that have already been set will have to be reset.

7.6 Staged Injection

1. Select the Start button 

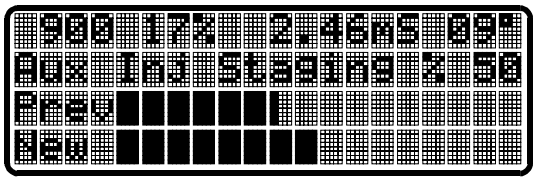
2. Choose menu 3 "Staged Injection" 

3. Use the left and right arrows to modify the injector staging to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

Injector Staging uses more than one injector per piston or rotor, to increase fuel metering accuracy at low RPM, and increase high RPM fuel delivery. The second injector stage is run from the Staged Injection output.

The Injector Staging menu is found by pressing buttons [1] and [3]. The Second Injector Stage is open for the displayed percentage range of 0% - 100% of the Primary Injector time.



Injectors have a dead-time when opening and closing. With small Injection times approaching this dead-time, there is a point when accurate fuel delivery is more difficult to achieve than when higher fuel delivery rates are required. For an engine using injectors with very high flow rates, Injector Staging can be used to increase the fuelling accuracy when the injectors are only required to be open for a short period, by forcing the second injector stage into injector cut-off.

For example: If the primary injectors are required to be open for 1.15mS for correct idle fuelling, the second injector stage can be run up to approximately 80% without the second injector stage delivering any fuel. To find the Primary Injector mS time, lower the Injector Staging to zero, and set the idle mixture. Once the idle mixture is found, slowly increase the Injector Staging. The Injector Staging value can be increased to the point when the idle speed or CO levels change. If this value is less than 75%, a compromise may have to be reached between total fuel delivery and idle emissions.

7.7 Air Temperature Compensation

1. Select the Fuel button 

2. Press the right arrow to toggle to the second layer of menus 

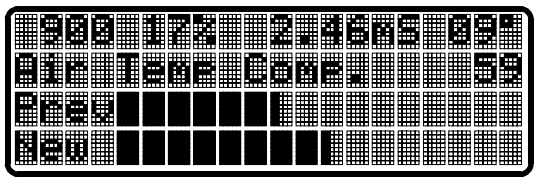
3. Choose menu 2 "Air Temp Comp." 

4. Use the left and right arrows to modify the compensation to your desired value 

5. Once you are happy with the value, use the Set button to retain the value 

As the temperature of the air entering the engine decreases, the engine can use more fuel to attain the correct air:fuel ratio and generate more power.

The opposite is also true. On a warmer day the engine needs less fuel and hence makes less power.



The Air Temperature Compensation progressively leans off the fuelling as the intake air temperature increases.

You are able to set the amount of air temperature compensation. The lower the value of compensation you set, the less the Wolf3D will decrease the fuel as the intake air temperature rises. You may decide that in a particularly stressful application, it is not worth the risk in leaning the fuelling off at all. We recommend setting the Air Temperature Compensation to 75. This is theoretically correct.

Sometimes this may be too much compensation. If the intake air temperature sensor is not in the correct position, it may not read the correct intake air. It is important that the intake air temperature sensor reads the intake air as late as possible. If possible mount the air temperature sensor in the plenum chamber. In this position air heated from the manifolding will be measured as the correct intake air temperature. It is vital on turbo applications to measure the intake air temperature **after** the turbo. On non-intercooled engines the after turbo air temperature can be as high as 100 Degrees Celsius, while the ambient air temperature may be as low as 25 Degrees Celsius. As you can see, the incorrect placement of the air temperature sensor can lead to incorrect fuelling over a wide range of intake air temperatures.

7.8 Coil Charge Time

1. Select the Ignition button 

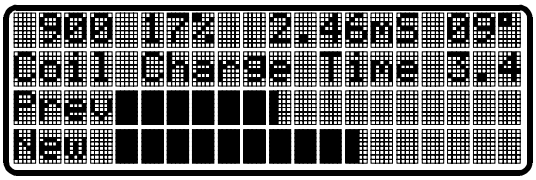
2. Choose menu 1 "Coil Charge Time" 

3. Use the left and right arrows to modify the charge time to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

This function is only used if the EMC is being used for ignition control.

The Coil Charge Time is used to optimise the engines ignition system by extracting the maximum energy from the ignition coil. The Coil Charge Time has a range of 1mS to 5 mS, adjustable in 0.1mS increments. To correctly set the Coil Charge Time, the engine must be under load with automotive ignition diagnostic equipment displaying the coil output.



If the coil charge time is set too low, the engine may miss-fire because the coil doesn't have enough time to fully charge. This means that there may not be enough spark energy to jump the plug gap at high engine loads. This is most common on turbo engines running high boost (greater than 15PSI or 1 Bar). If the coil charge time is set high and there are still miss-fire problems, the sparkplug gaps may have to be reduced. If the engine has not been tuned correctly, lean fuel miss-fire might be confused with spark miss-fire. The only way to determine the type of miss-fire is to analyse the exhaust gasses, or the ignition system. Both tests are most easily done on a dyno so you can load the engine up until it miss-fires.

NOTE: If the ignition system is triggering Bosch Ignition Module/s P# 9 222 067 024, the charge value should be set to 3.8mS.

7.9 Trail Pulse – Rotary

1. Select the Ignition button 

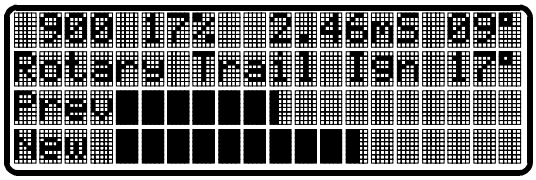
2. Choose menu 2 "Trailing Pulse Rotary" 

3. Use the left and right arrows to modify the ignition split timing to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

The trailing ignition pulse for rotary engines has a span of 11 to 22 degrees, in steps of 0.25 degrees. Check the ignition timing with a timing light to confirm Trailing Pulse angle.

Different rotary engines are factory set at different trailing ignition splits between 10 and 20 degrees. Running the split at 11 degrees will not cause the engine any problems.



Ask the engine supplier for details on correct Trailing Pulse angle for the engine being installed.

The trailing spark on a rotary engine is there primarily for emission purposes and to increase fuel economy. Approximately 95% of the engines power is produced by the leading sparkplug.

The leading and trailing sparkplugs should not be fired at the same time, as at certain RPMs, there may be some detonation caused by the two flame fronts colliding.

For 20B applications, the Wolf3D must be run in 6 cylinder mode. The three ignition outputs of the Wolf3D in this mode may be used to fire the leading plugs only. Alternatively, an external triple rotor ignition splitter may be used for the trailing plugs. Consult your Wolf3D dealer for more information on the triple rotor ignition splitter.

7.10 Rotary Ignition Mode

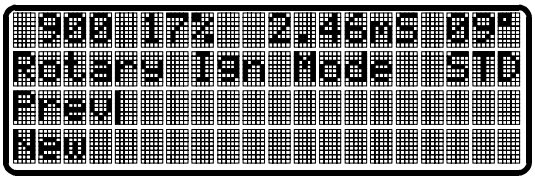
1. Select the Ignition button 

2. Choose menu 3 "Rotary Ignition Mode" 

3. Use the left and right arrows to modify the ignition mode to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

Rotary Ignition Mode selects between the original Mazda coil packs and igniters, and using 3 Bosch modules and coils. To adjust this setting press [4], [3]. Use the left and right arrows to step between the two values. Press [SET] to store the value.



Mazda Mode refers to the coil packs used on 13B powered RX7's from 1986-'88. These are also known as 'Series 4' and 'Second Generation' RX7's. One igniter drives a dual output coil for the leading sparkplugs, while the second igniter drives two individual coils for the trailing sparkplugs. Series 5 igniters are not compatible with the Wolf3D.

STD Mode refers to the ignition output of the Wolf3D driving 3 individual igniters. One igniter drives a dual output coil for the leading sparkplugs, while two more igniters drive two single output coils for the two trailing sparkplugs. This method is preferred by us for high performance applications.

Refer to Section 8 for more information on Mazda wiring details.

7.11 Ignition Output Mode

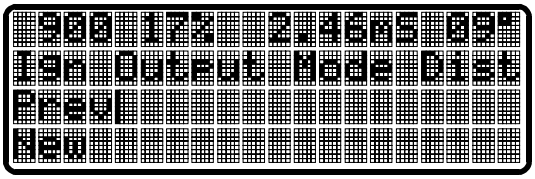
1. Select the Ignition button 

2. Choose menu 4 "Ignition Output Mode" 

3. Use the left and right arrows to modify the ignition output mode to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

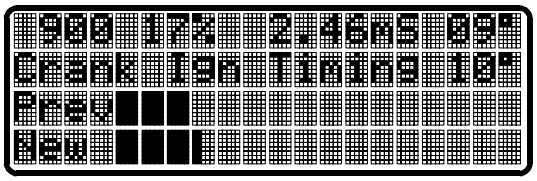
The Ignition Output Mode switches between Multi-coil and Distributor type of output. Press [4], [4] to move to the Ignition Output Mode menu. Use the left and right arrows to switch between Multi-coil and Distributor type output. Press [SET] to save the value.



7.12 Setting Cranking Ignition Timing

1. Select the Start button
2. Choose menu 2 "Crank Ignition Timing"
3. Use the left and right arrows to modify the ignition timing to your desired value
4. Once you are happy with the value, use the Set button to retain the value

The Cranking Ignition Timing in degrees is Shown in the top right-hand corner of the display, and is adjustable from 0 to 45 degrees. Set the Cranking Ignition Timing to 0 de g. using [<-]. Press [SET] once 0 deg. has been entered. The EMC will return to the Main Screen.



Before cranking the engine, the Ignition Offset Adjust should be set at +00 allowing the Installer the most flexibility when setting up the Ignition Timing. To set the Ignition Offset Adjust, [->], [4], using [<-] and [->] to adjust the value to +00.

[->] Advances the ignition timing.
[<-] Retards the ignition timing.

Set the Cranking Fuel Rate to zero.

Crank the engine with a timing light on the crank, taking note of the timing position. The timing mark may be either before or after Top Dead Centre, (TDC). To make sure the display shows the user the correct Ignition Timing, the display must show the same crank angle the timing light is showing. Since the Cranking Ignition Timing is set at 0 deg. , the timing light should show 0 deg. Although the Ignition Offset Adjust function may be used to correct the EMC's displayed value, it affords more flexibility in the future to move the pickup, whether it be a crank angle sensor, an optical, or points distributor pickup, if possible, until the timing light shows 0 deg. Trim the value with the Ignition Offset Adjust using buttons [<-] and [->].

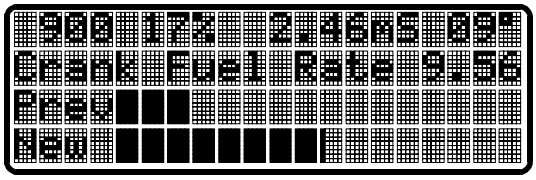
If the timing light shows the spark is occurring before TDC, use the Ignition Offset Adjust to move the timing mark using [<-] until it is at TDC.
If the timing light is showing the spark occurring after TDC the Ignition Timing is retarded, therefore the Ignition Offset Adjust should be moved to the right [->], bringing the Ignition timing back to TDC.

The Cranking Ignition Timing can now be set to an appropriate value for the type of engine being installed.

7.13 Set Cranking Fuel Rate

1. Select the Start button
2. Choose menu 1 "Crank Fuel Rate"
3. Use the left and right arrows to modify the injector time to your desired value
4. Once you are happy with the value, use the Set button to retain the value

The Cranking Fuel Rate has a range double that of the Injection Scale Adjust. For example, if the Injection Scale Adjust is set to 10mS, the maximum Cranking Fuel Rate is 20mS. Before setting the Cranking Fuel Rate, set the Cold Enrich to zero, by pressing [3], [3] to move to the Cold Enrichment parameter. Use the [<-] to set the value to zero. Pressing [SET] will store the value and return to the Main Screen.



Set the Cranking Fuel Rate to one third of the predetermined full scale injection time (Refer to section 7.5). To locate this function from the main display area press the [1] button then the [1] button to bring up the Cranking parameter..

Start cranking the engine whilst pressing the [->] button to slowly increase the cranking fuel value until the engine fires. The cranking value only operates when the engine is running at less than 500 RPM, therefore the engine may try to start, but then quickly stall. This may mean the Fuel and Ignition Points adjacent to the Cranking Points are set incorrectly and may need to be adjusted.

When satisfied with that value store it by pressing [SET]. The computer automatically returns to the main display screen.

7.14 Installation and Setup Check List

This checklist covers both injection and ignition installation references. If the WOLF3D is only used for injection or ignition disregard the irrelevant sections:

Battery connections	
Earth connection	
Fuel pump and lines	3.2
Input trigger	5
Water temperature sensor	5.2
Air temperature sensor	5.3
Throttle position sensor calibration	5.4
Oxygen sensor	5.5
Hand controller installation	7.0
DIP switch selection	7.2
Set full scale injection time	7.5
Staged injection	7.6
Coil charge time	7.8
Trailing pulse rotary	7.9
Set cranking ignition timing	7.12
Set a basic ignition curve	8.3
Set cold enrichment	10.1
Set rev limit	10.3
Set fuel cut on overrun	10.4

The following outputs ground the device being used. They do not supply +12V to the device:
Thermo-fan output relay driver.
Fuel Pump output relay driver.
Fuel injection banks 1A, 1B, 2A, 2B and Staged Injection output.

When this checklist has been covered, the engine is ready to crank.

The following list should be checked while the engine is cranking:
Fuel pump LED on hand controller illuminates
A valid RPM signal is indicated on the hand controller screen

Once the engine has been cranking the following list should be checked:
Check cranking ignition timing with a timing light
Check for fuel leaks from fuel lines and around injector seals

Once all above checks have been completed the engine should be ready to run.

7.15 Cranking the Engine for the First Time

Follow these step by step instructions to quickly and easily get your engine started with the minimum of fuss.

1. Disconnect the IGN-1 loom
2. Disconnect +12V power to the injectors
3. Check engine oil and water
4. Have the Wolf engine management system in view with both sets of diagnostic LED's visible
5. Have the Hand Controller plugged into the Wolf3D
6. Crank the engine and take account of the following:

- Does the green Fuel LED on Hand Controller illuminate? It should
- Does the red input trigger LED on the side of the Wolf3D flash? It should
- Is there RPM displayed on the Hand Controller and is it of a reasonable value. 150 – 350 RPM
- Does the black error input trigger check block next to the RPM go out? It should
- Do the yellow injector output LEDs flash as the engine is cranking? They should
- Do the red ignition LEDs flash as the engine is cranking? They should

If everything in point 6 is working properly, go to step 7. Otherwise check the relevant sections of the manual to determine if there are any set up or configuration faults.

7. Reconnect to IGN-1 loom
8. Put a timing light onto high tension ignition lead for cylinder 1
9. While watching the crankshaft, turn the engine over
10. The timing mark must be within 10 degrees of the ignition value displayed on the Hand Controller
11. If the mark is greater than 10 degrees out, the trigger sensor will have to be moved
12. When the ignition timing is correct, reconnect the +12V supply to the injectors
13. Crank the engine
14. If the engine does not start, you will have to change the cranking fuel rate
15. Once the engine is idling, allow it to warm up to 80 deg. C
16. Now it's time to tune your engine.

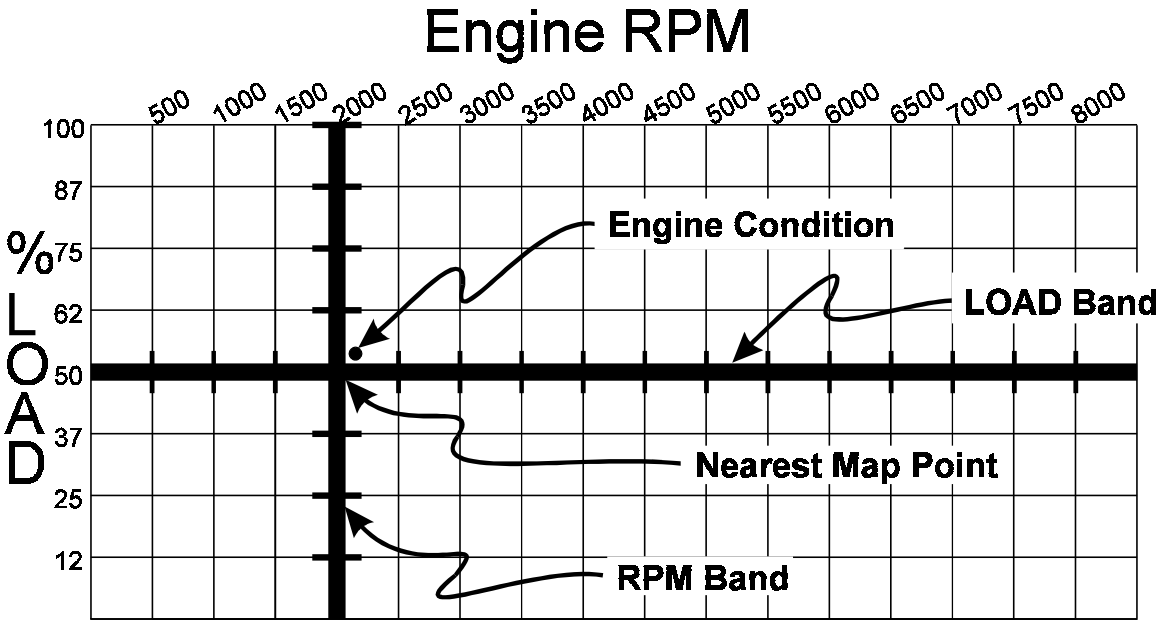
The WOLF3D has an input trigger diagnostic function in the form of a dark block directly to the right of the RPM digits. This block appears while the engine is not running, during the initial stages of cranking, as well as when an invalid Trigger Input signal is encountered.

While this block is on the EMC will not turn on the Injectors or charge the Ignition Coil. Data Logging section 10 describes the Signal Error Counter. This counter increments each time the WOLF3D receives an invalid trigger signal. If this counter is incrementing something must be done to improve the input trigger filtering.

If the block is on while cranking the engine or while the engine is running, it may be necessary to increase the input filtering, or check the trigger sensor mounting or connections. For input filtering information, see DIP Switch selection table in section 7.2.
For more information on fault diagnostics contact an Advanced Engine Management Distributor.

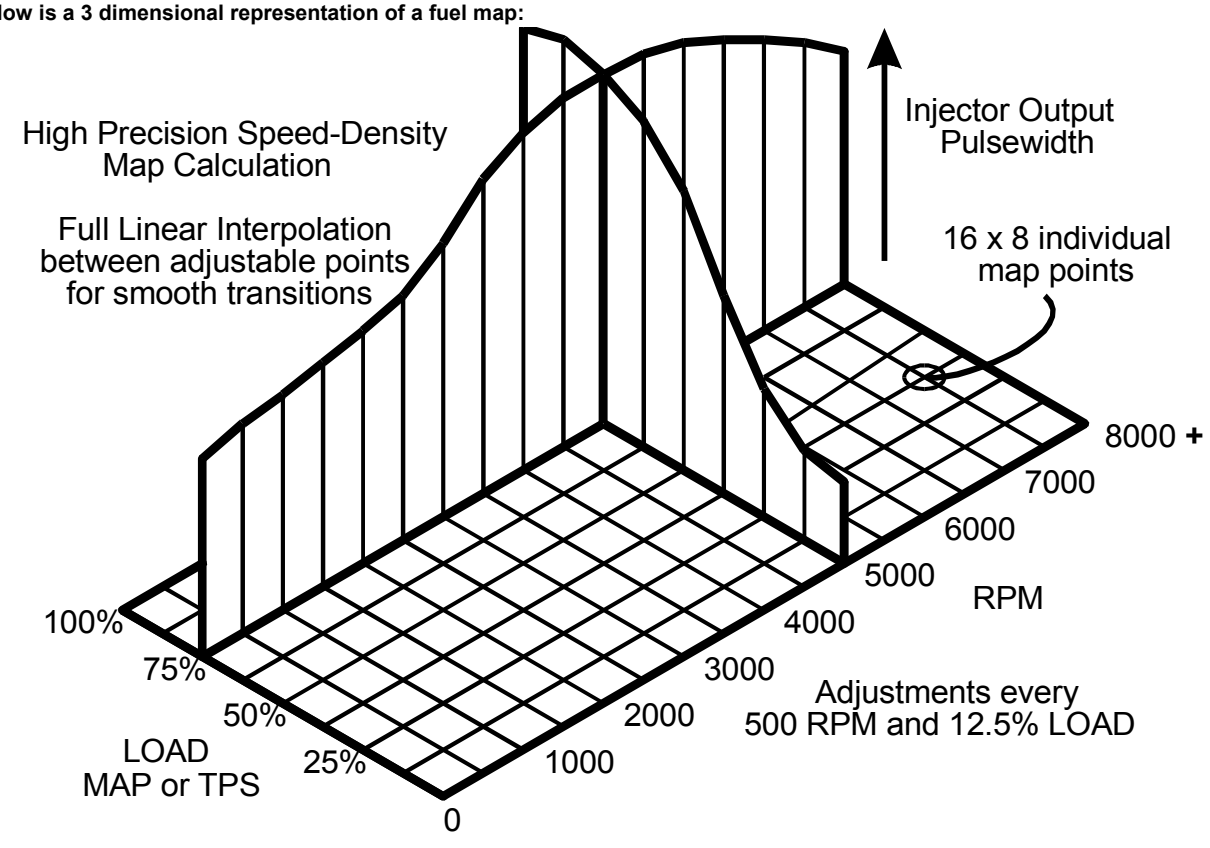
8. Map Basics

The diagram below is a visual representation of the Map programming functions. At each pair of intersecting LOAD and RPM Bands is a Map Point. At this point is the Injection time or Ignition timing.



In the above diagram: the actual Engine Condition is 54% LOAD @ 2200RPM
the Nearest Map Point is 50% LOAD @ 2000RPM
the Nearest RPM Band is the 2000RPM Band
the Nearest LOAD Band is the 50% Band.

Below is a 3 dimensional representation of a fuel map:



8.1 Moving Around The Map (Map Step Function)

The WOLF3D allows the user to move around the Fuel and Ignition Maps. This allows the setting up of Maps and diagnosing any 'flat spots' very quick and simple, as the whole Map can be stepped through without having to run the engine.

When in Map Adjust Mode, the [1], [2], [3], and [4] buttons function as left and right arrows to move around the Map.
1- LOAD down 2- LOAD up
3- RPM down 4- RPM up

To step through the Fuel Map choose [<-INJ], [1], which picks the nearest Injection Map point.
The nearest Injection Map point is the closest point to which the engine is running.

If the engine is not running the EMC chooses the 500RPM point at the LOAD the engine experiences while not running.

Then step through the Fuel Map using [3], [4] for RPM points, and [1], [2] for LOAD Points. The value of each Fuel Map point is displayed on the screen. The Ignition Map points can be seen just as easily by choosing [IGN->], [1] and then moving throughout the Ignition Map in the same way is in the Injection Map.

Try out this function by pressing [<-INJ], [1], and then press [1], [2], [3] and [4]. Press [CLR] when finished to ensure you don't change any Map values.

If an adjustment is to be saved press [SET] to write it before stepping away from that point by pressing buttons [1], [2], [3] or [4], or pressing [CLR].

The display will stay in the current mode unless [CLR] is pressed to return to the main screen.

8.2 Modifying Fuel and Ignition Values

There are four ways of modifying the Fuel Maps in the WOLF3D.

- Nearest Injection Map Point
- LOAD Band Move
- LOAD Band Reset
- Injection Scale Adjust

There are four ways of modifying the Ignition Maps in the WOLF3D.

- Nearest Ignition Map Point
- RPM Band Move
- RPM Band Reset
- Ignition Offset Adjust

8.2.1 Nearest Map Point (Injection):

1. Select the Fuel Map button 

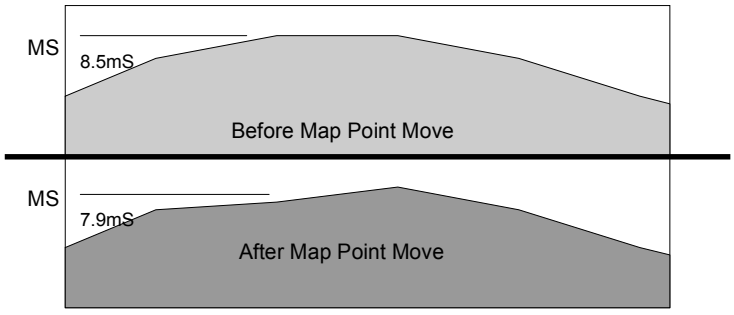
2. Choose menu 1 "Nearest Map Point" 

3. Use the left and right arrows to modify the injection time to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

This function allows the user to set **one** Map Point at a time. Refer to sections on, Setting Ignition Map Points and sections on, Setting Fuel Map Points for application information of this function.

The graph below is an example of one Load Band eg 75%



8.2.2 LOAD Band Move (Injection only):

1. Select the Fuel Map button 

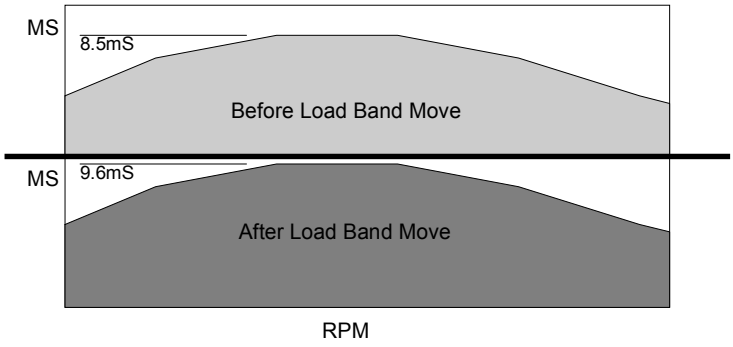
2. Choose menu 2 "Load Band Move" 

3. Use the left and right arrows to modify the injection time to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

This function allows the user to raise or lower an entire LOAD Band containing 16 RPM Points, maintaining the Fuel curve over the entire RPM range. This function can be used to change and air : fuel ratio of a particular Load Band at each RPM.

The graph below is an example of one Load Band eg 75%



8.2.3 LOAD Band Reset (Injection only):

1. Select the Fuel Map button 

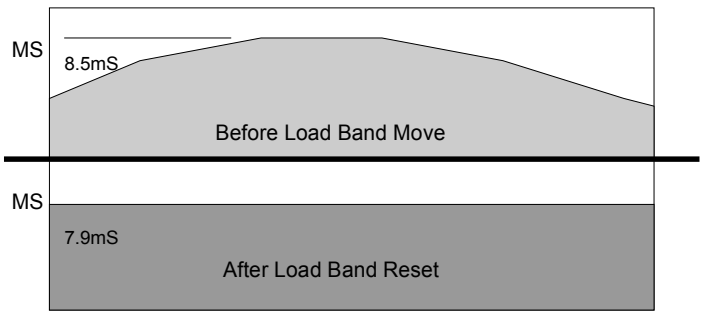
2. Choose menu 3 "Load Band Reset" 

3. Use the left and right arrows to modify the injection time to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

LOAD Band Reset flattens the Fuel curve at all RPM Points on the particular LOAD Band. This is a powerful function that should only be used either before any fine tuning has begun, or if the user is completely 'lost', ie. cannot find the correct fuelling and the injection times at each RPM site on a Load Band are inconsistent. As a safety feature the function will only work if the Injection time has been changed while in LOAD Band Reset mode. If the value has not been changed, when [SET] is pressed, all original Injection times will remain.

The graph below is an example of one Load Band eg 75%



Load Band Reset is very useful if you have lost your way when programming a fuel map. It can be far quicker to do a Load Band Reset, then modify a few points, than it would be to have to step through every point on a Load Band and change all but a few of the points.

8.2.4 Injection Scale Adjust (Injection only):

1. Select the Fuel Map button 

2. Choose menu 4 “Injection Scale Adjust” 

3. Use the left and right arrows to modify the injector scale to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

The Injection Scale Adjust allows the user to setup the finest possible steps between Injection values within the Fuel Map.

To Optimise the precision of the Wolf3D, you should set the Injection Scale Adjust to the point corresponding to the RPM of maximum power.

Refer to section 7.5 for information regarding setting the Injection Scale Adjust .

8.2.5 Nearest Map Point (Ignition):

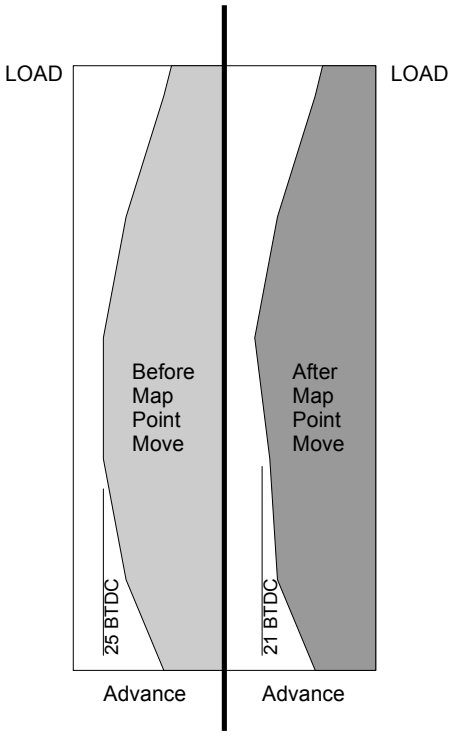
1. Select the Ignition Map button 

2. Choose menu 1 “Nearest Map Point” 

3. Use the left and right arrows to modify the ignition timing to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

This function allows the user to set **one** Map Point at a time.



The graph above is an example of one RPM Band eg 2000 RPM

8.2.6 RPM Band Move (Ignition only):

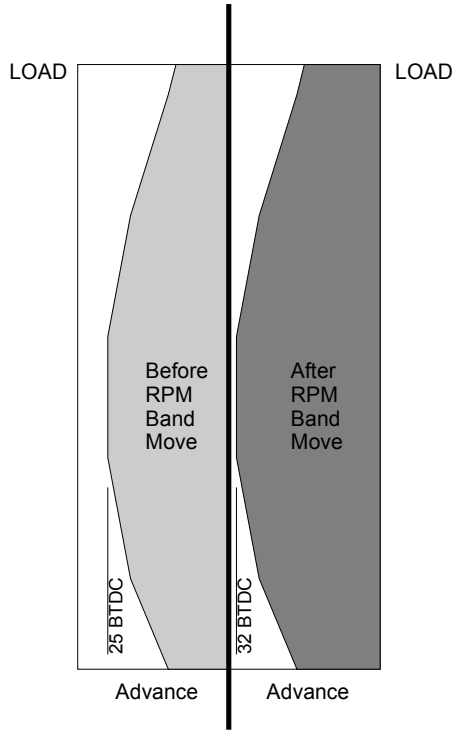
1. Select the Ignition Map button 

2. Choose menu 2 "RPM Band Move" 

3. Use the left and right arrows to modify the ignition timing to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

RPM Band Move allows the user to raise or lower all eight LOAD Points on the RPM Band, maintaining the Ignition Curve or the entire LOAD range.



The graph above is an example of one RPM Band eg 2000 RPM

8.2.7 RPM Band Reset (Ignition only):

1. Select the Ignition Map button 

2. Choose menu 3 "RPM Band Reset" 

3. Use the left and right arrows to modify the ignition timing to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

RPM Band Reset flattens the Ignition curve at all LOAD Points on that RPM Band. As with LOAD Band Reset, this function should be used with caution.

As a safety precaution, this function will only work if the Ignition Timing has been changed while in RPM Band Reset mode. If the value has not been changed, before [SET] is pressed, all original Ignition values will remain.

8.2.8 Ignition Offset Adjust (Ignition only):

1. Select the Ignition Map button 

2. Choose menu 4 "Ignition Offset Adjust" 

3. Use the left and right arrows to modify the ignition offset to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

Ignition Offset Adjust can be used to calibrate the Ignition value displayed on the Hand Controller, to the engines actual Ignition timing. Refer to Section 7.12 for more information.

8.3 Setting A Basic Ignition Curve

A basic Ignition Map must be stored in the EMC, (it will be fine tuned later), before any Fuel values are set. Below is an example of a very basic Ignition Map.

RPM	500	1000	1500	2000	2500	3000	3500	4000
ADVANCE	10 deg	8 deg	12 deg	15 deg	17 deg	20 deg	25 deg	25 deg

RPM	4500	5000	5500	6000	6500	7000	7500	8000
ADVANCE	25 deg	25 deg	25 deg	25 deg	25 deg	25 deg	25 deg	25 deg

The 500 RPM ignition timing is 2 degrees more advanced than the 1000 RPM ignition timing. This is set for an engine that will idle between 500 and 1000 RPM. Having more advance at 500 RPM will give the engine a more stable idle, since when the engine begins to slow down, the ignition timing is advanced, producing more engine torque and increasing the engine speed accordingly. The difference between the adjacent timing points should not be more than a few degrees, as engine speed "cycling", (engine speeding up then slowing down repeatedly) may occur.

To set the above Ignition Curve, use the Map Step Function (See Section 0), in conjunction with RPM Band Move under the Ignition menu. Press buttons [->] and [2] for RPM Band Move, and step down the RPM Bands to 500 RPM adjusting the Ignition Timing up and down using the arrow buttons until a desired value is reached. Pressing [SET] will store this value. Move up the RPM Bands adjusting the values and pressing [SET] once correct values are obtained.

9. Dyno Tuning

9.1 Dynamometer Facilities

The facilities available will have a large bearing on how successfully the engine will be tuned. The hourly rate charged at a dyno shop will not necessarily reflect the speed and accuracy of the job they will do. Before choosing a particular dyno shop ask the manager about their equipment. Ask if the operator tuned many after-market EFI systems. If a turbo motor is to be tuned, ask whether the shop does much turbo-charged engine EFI tuning.

Ask your WOLF3D Distributor for advice on an appropriate dynamometer facility.

The workshop will need to have a chassis dyno, an exhaust gas analyser measuring CO, O2, CO2, HCF, (or a high speed air : fuel ratio meter), an electronic engine ignition analyser, and an experienced operator.

One of the most forgotten pieces of equipment is the dynamometer fan. It is important that a large fan is available, since cooling an engine, gearbox and differential on a chassis dyno is very difficult. If a large fan is not available, the time required to tune the engine may increase considerably, allowing for cooling time, hence an increase in tuning cost. What is more important is the increased strain on the engine that may be running very hot under full load conditions for extended periods of time.

Many Dynos now have what is called auto ramp-up. This means the dyno loads up the engine, and allows the engine to increase in RPM at a determined rate. The main advantage of this, is that you should get a printed graph of your cars dyno runs. This type of dyno system places much less stress on the engine and drive line because the engine does not have to sit at high RPM for long periods of time, as the dyno readings stabilise. The best known dyno manufacturer in Australia of high quality dynos with ramp-up is Dyno Dynamics. They have become the benchmark which all other dynos are measured.

10. Tuning for Increased Drivability

These functions should be adjusted once the fuel and ignition Maps have been tuned.

10.1 Cold Enrichment

1. Select the Fuel button 

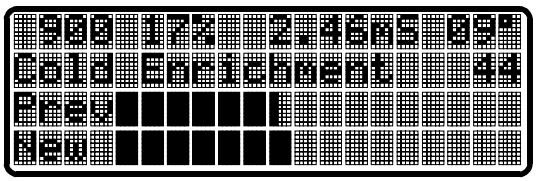
2. Choose menu 3 "Cold Enrichment" 

3. Use the left and right arrows to modify the cold enrichment to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

Functions the same as the choke on a carburetted car. The Cold Enrichment threshold is 70 deg.C. As the temperature drops below this level enrichment begins. The enrichment increases as the temperature approaches 0 deg.C. The Cold Enrichment value can only be tuned when the engine is cold. That would be when the engine has not been run for at least 8 hours.

To set the Cold Enrichment, press [3], [3]. Then try to start the engine. If there is any trouble starting the engine, adjust the Cold Enrichment until the engine starts and runs correctly when cold. This calibration may need to be done more than once if it took more than just a few tries to get the setting correct the first time. To set the Cold Enrichment when an acceptable value has been found, press [SET].



10.2 Acceleration Enrichment

There are two ways of implementing the Acceleration Enrichment, via Throttle Position or MAP Sensor. This is determined by the DIP Switch selection made in section 7.2. Either way the set-up procedure is the same once the steady state Fuel Map and Ignition Map (if applicable) have been correctly set.

When setting up the LOAD Bands the engine may have hesitated when the throttle was opened quickly. That is because the Acceleration Enrichment was not set correctly. The Acceleration Enrichment combines two components, Acceleration Enrichment and Acceleration Sustain.

The Acceleration Enrichment increases the fuelling to the engine by a user definable amount dependent on the engines requirements. The Sustain sets the rate at which the enrichment decreases over time. 0 means an extremely rapid decay, 100 means a very long sustain. These two parameters allow the setting of a sharp throttle response. To make setting the Acceleration Enrichment easier, first set the Sustain to 50. To do this, use buttons, [3], [2] then adjust the value to 50 using the arrow buttons.

To set the Acceleration Enrichment Rate, go to the appropriate menu, [3], [1]. With the engine running at idle open the throttle half way quite quickly and release it quickly. The engine may have bogged down. To tune the Acceleration Enrichment Rate, feather the throttle as described above and adjust, the parameter using the arrow buttons until the engine responds cleanly. Remember, this is a preliminary tune, so if a snap throttle response is not achievable at this stage don't worry, the individual Fuel Map points may need some adjustment that should be done on a chassis dyno. The car should now be quite drivable.

It is vital that you set up the fuel and ignition map points before you spend too much time on setting up the acceleration enrichment rate and sustain. Acceleration enrichment modifies the amount of fuel being delivered, based on the change in throttle position. If the fuel and ignition maps are incorrect, the acceleration enrichment will not be able to cover up these problems.

10.2.1 Acceleration Enrichment Rate

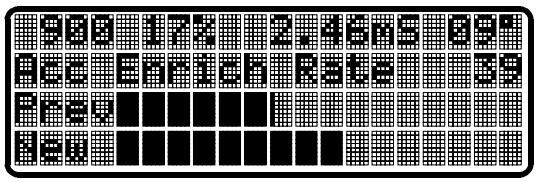
1. Select the Fuel button 

2. Choose menu 1 “Accel Enrichment Rate” 

3. Use the left and right arrows to modify the Enrichment Rate to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

To modify the Acceleration Enrichment Rate use [3], [1]. Change the value of the parameter using [<-], [->]. Increasing or decreasing the Acceleration Enrichment Rate until an acceptable engine response when rapidly opening the throttle has been achieved. This response can be enhanced using Acceleration Enrichment Sustain.



10.2.2 Acceleration Enrichment Sustain

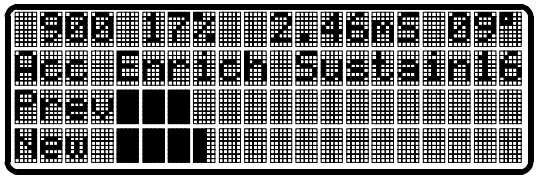
1. Select the Fuel button 

2. Choose menu 2 “Accel Enrich Sustain” 

3. Use the left and right arrows to modify the Enrichment Sustain to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

Not only is the Rate of Acceleration Enrichment required, also the length of the enrichment (Sustain), is important in providing a crisp throttle response. This function is difficult to quantify for different engine types, although begin the Sustain level at 50. Once the Acceleration Enrichment Rate has been set to an optimum level, fine tune the Acceleration Enrichment Sustain to fine tune the Acceleration Enrichment. To set the Acceleration Enrichment Sustain use [3], [2]. Increase or decrease the level with [<-], [->] until throttle response is maximised. To store the Acceleration Enrichment Rate and Sustain press [SET].



10.3 Rev Limit

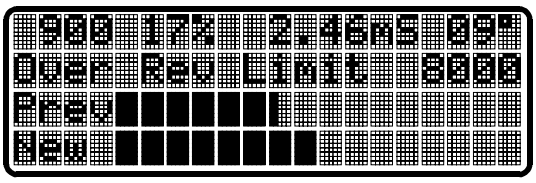
1. Select the Limits button 

2. Choose menu 1 "Over Rev Limit" 

3. Use the left and right arrows to modify the rev limit RPM to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

The Rev Limit function is found under the LIMITS Menu. Press buttons [2], then [1] to move to the Rev Limit parameter adjustment. The bargraph at the bottom of the screen represents the RPM the Rev Limiter will be applied. Each block is equal to 1000 RPM. Use the [<-], and [->] buttons to adjust the Rev Limit point. To set the point press the [SET] button. The Rev Limiter functions in the range of 2000 to 12000 RPM in 250 RPM increments.



10.4 Fuel Cut on Over-run

1. Select the Fuel button 

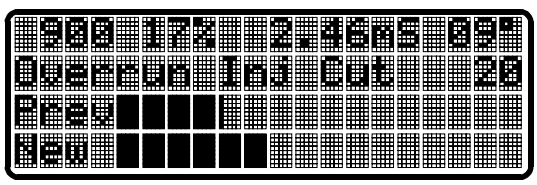
2. Choose menu 4 "Fuel Cut On Overrun" 

3. Use the left and right arrows to modify the load level to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

This function is used to both increase economy and reduce backfires and afterburning while coasting. When the throttle is closed as when coasting down a hill or when changing gears it is not necessary to deliver fuel to the engine.

Fuel Cut on Over-run reduces the injection time to zero. It is implemented if the engine is above an RPM you determine (1200RPM or greater), and the throttle position is below a value you set. The Fuel Cut is cancelled bellow the RPM you determined. The User set throttle position level allows the sensitivity of the Fuel Cut to be tailored to the engine, driver, vehicle combination. If in doubt, set this function to zero.



10.5 Over Temp Warning

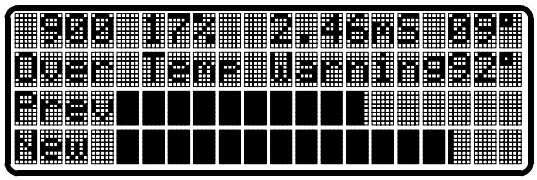
1. Select the Limits button 

2. Choose menu 2 "Over Temp Warning" 

3. Use the left and right arrows to modify the temperature to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

On the front of the WOLF3D Hand Controller is an Over Temp Warning indicator light. The light comes on when the engine's water temperature exceeds a user set level. The Over Temp Warning parameter is under the Limits menu. Press button [2] twice to go to the Over Temp Warning parameter adjust screen. The current value is displayed in degrees Celsius on the right side of the display directly above the bargraphs.



10.6 Turbo Timer

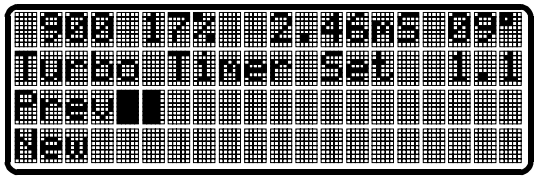
1. Select the Limits button 

2. Choose menu 3 "Turbo Timer" 

3. Use the left and right arrows to modify the idle down time to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

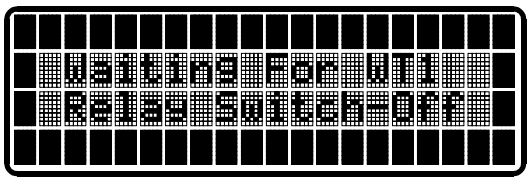
The Turbo Timer function will only operate with the WOLF3D Turbo Timer Option. It is adjustable from 1 to 10 minutes in 0.1 minute steps. Below 1 minute, the timer is set to zero and "OFF" is displayed. When the engine is running on the Turbo Timer, the engine can be 'killed' at any time by pressing any button on the Hand Controller. While the Turbo Timer mode is active, the WOLF3D will rev limit the vehicle to 2000 RPM. The WOLF3D will then switch off until the power is applied to the EMC again. Press buttons [2] then [3] to gain access to the Turbo Timer parameter adjust.



When the ignition switch is turned off, the turbo timer relay cuts in maintaining power to the vehicles ignition relay. With the ignition switch off, a 'T' will appear on the main screen, in the centre of the top line next to the Load percentage. This signifies the Turbo Timer is active. If the ignition switch is turned back on, the 'T' will disappear, indicating the WOLF3D is in normal operating mode.

The Turbo Timer bypass link must be unplugged, and be replaced by the WOLF3D Turbo Timer Option. Refer to the wiring diagrams at the rear of this manual for wiring information.

In case of faulty wiring, the WOLF3D has an error screen to show the user that power is still being delivered to the ECU, but the turbo timer time has been exceeded. The hand controller will display the error message:



Under normal operation this error message is not displayed.

The Turbo Timer will not activate if the engines water temperature is below 70 degrees.

10.7 Post Start Enrichment

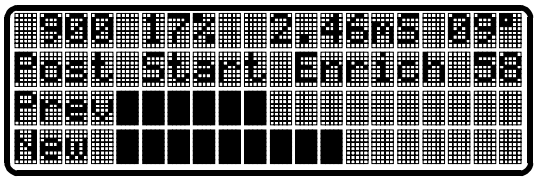
1. Select the Start button 

2. Choose menu 4 "Post Start Enrichment" 

3. Use the left and right arrows to modify the parameter to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

Many engines benefit from additional fuel for a few seconds after starting. If the engine tends to stall or stutter immediately after starting, some Post Start Enrichment may solve the problem. This problem is increased in turbo engines where heat soak can be a problem when starting a warm engine that has been left to sit for a few minutes. The air temperature sensor is tricked into thinking the intake air is much hotter than it really is. The EMC then ties to idle the engine slightly leaner than normal. Since idle fuel control is critical, this may mean the engine will not even idle with the slightly lean mixture.



To adjust the Post Start Enrichment press [1], then [4] to move to the Post Start Enrichment menu. The [<-] and [->] buttons, decrease and increase the amount of Post Start Enrichment being added to the fuel already being delivered to the engine. Before spending too much time on setting the Post Start Enrichment, make sure the ignition timing, Cranking Fuel Rate and Fuel Map around the idle area are correctly set.

Trial and error is the only way to set the Post Start Enrichment. It will make the engine start and run far more smoothly when tuned than if it were not present, or if it were set incorrectly.

The Post Start Enrichment decay rate is proportional to the inlet air temperature. As the inlet air temperature decreases, the compensation value decreases.

10.8 Idle Lock TPos

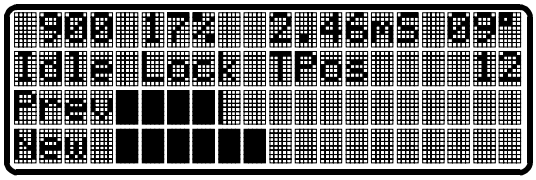
1. Select the Limits button 

2. Choose menu 4 "Idle Lock @ Tpos" 

3. Use the left and right arrows to modify the parameter to your desired value 

4. Once you are happy with the value, use the Set button to retain the value 

The Idle Lock function can be used on engines when manifold vacuum is being used for Load calculations. The engine must have a throttle position sensor. This feature uses the throttle position sensor to determine when the throttle is closed and if the engine speed is under 1500 RPM, the ECU disregards the manifold vacuum and delivers a constant amount of fuel. This is most useful on engines with large cams or rotary engines with radical porting. If idle has been a problem because of poor vacuum at idle, Idle Lock at TPos will overcome this.



To implement Idle Lock at TPos, press [2], [4]. The value displayed is the throttle position at below which Idle lock will work. If the engine has a closed throttle TPos value of 17, set the Idle Lock at TPos to 18, and each time the RPM drops below 1500 and the TPos is below 18 the Idle Lock will be operational.

To set the fuelling value at Idle Lock adjust the 12% 500RPM fuel map point. This point is the actual fuelling value that will be delivered regardless of the manifold vacuum when the throttle position value is on or below the Idle Lock TPos value. When the Idle Lock TPos function is activated, a small block appears next to the TPos value on the main screen.

The WOLF3D has a flood clear function which stops any fuel being injected when cranking. If the throttle position is between 75 and 98, no fuel will be delivered and an FC will appear next to the millisecond time on the main screen.

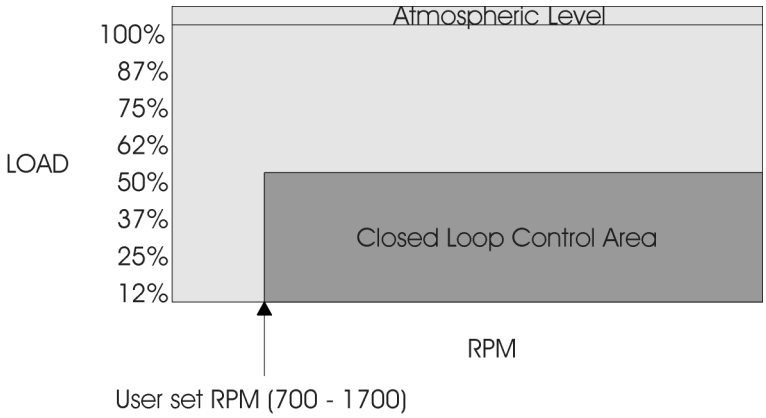
11. Closed Loop Control

The Wolf3D has a Closed Loop Control function that enable the ECU to maintain an Air : Fuel ratio of 14.7 : 1 so that the function of a catalytic converter will work correctly and last its full life. Closed Loop Control is not a magic wand to cure all vehicles tuning problems. It is only of real use when a catalytic converter is being used.

The diagrams below show the conditions under which Closed Loop Control will operate.

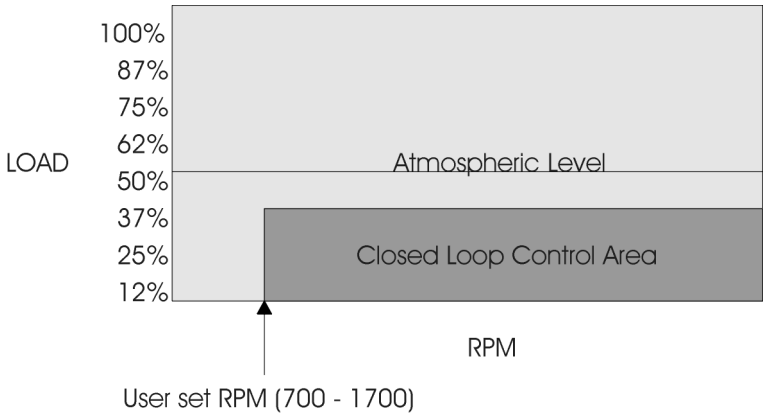
Normally aspirated:

With the Wolf3D set up in Normally Aspirated Mode, approximately 93% load is atmospheric, that is there is neither vacuum or boost acting on the engine. In Normally Aspirated Mode, the Closed Loop Control Area is bound by the 50% load band, and an RPM that you set. While above this RPM and below 50% load, the Wolf3D will run in Closed Loop Mode.



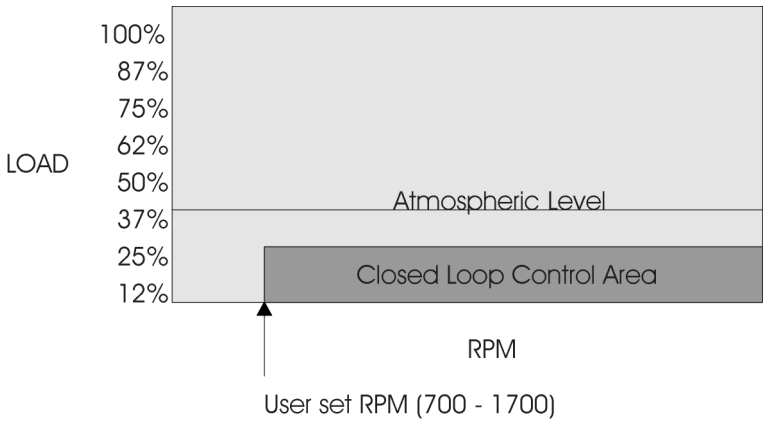
12 PSI Boost Mode:

With the Wolf3D set up in 12 PSI Boost Mode, approximately 50% load is atmospheric, that is there is neither vacuum or boost acting on the engine. In 12 PSI Boost Mode, the Closed Loop Control Area is bound by the 37% load band, and an RPM that you set. While above this RPM and below 37% load, the Wolf3D will run in Closed Loop Mode.



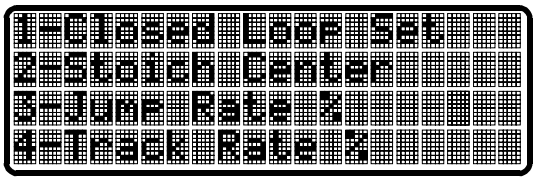
21 PSI Boost Mode:

With the Wolf3D set up in 21 PSI Boost Mode, approximately 37% load is atmospheric, that is there is neither vacuum or boost acting on the engine. In 21 PSI Boost Mode, the Closed Loop Control Area is bound by the 25% load band, and an RPM that you set. While above this RPM and below 25% load, the Wolf3D will run in Closed Loop Mode.

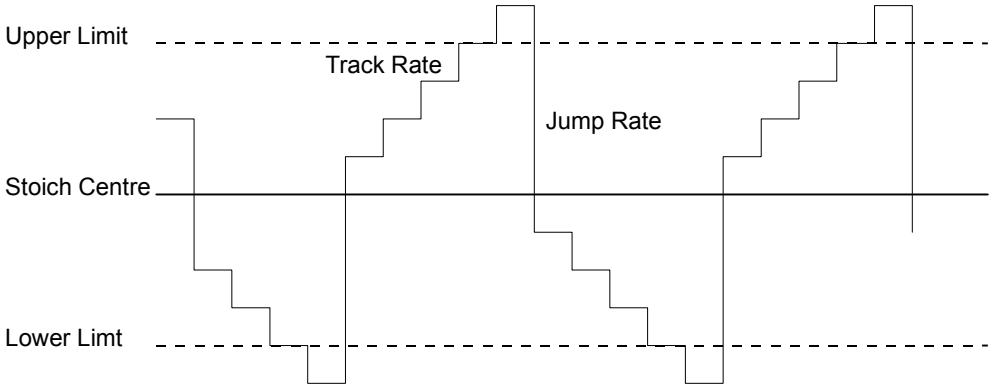


11.1 Closed Loop Control setup procedure

- An oxygen sensor (preferably 4 wire with heating element and earth cable) must be used for Closed Loop Control to work.
- Set all fuelling points within the operation window to 14.7:1 air:fuel. The oxy bar graph on the main screen of the Wolf3D can be used to check this. **This is critical since, if the Wolf3D has to increase or decrease the fuelling too much, it will decide that the oxygen sensor is faulty, an turn the closed loop off.**
- Check that the following parameters are set to the default settings:
- Stoichiometric Ratio 50
- Track Rate 1
- Jump Rate 1
- Bring the engine up to operating temperature (above 70 deg.C)
- Run the engine within the operating window.
- Watch the bargraph on the main screen move up and down.
- If it is showing rich and lean too slowly (it should cycle about once a second), increase the jump and track rates until a smooth and even cycle is in effect.
- If the Jump or Track Rate is set too high the engine may run roughly (surge) because the fuelling is being deceased too much at some points.

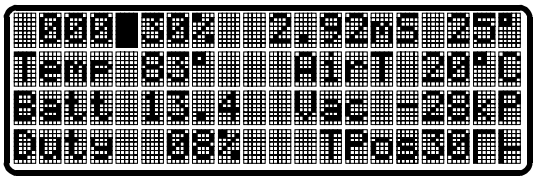


Closed Loop Menu



Closed Loop Control System

Stoich Centre – User set stoichiometric Centre
Upper Limit – Factory set upper limit
Lower Limit – Factory set lower limit
Jump Rate – User set jump rate
Track Rate – User set track rate



When Closed Loop id operating, the too bargraph second from the right will be in the uppermost position. The oxy bargraph should be oscillating up and down with the centre of oscillations being around the centre of the bargraph.

If the Wolf3D determines that the fuelling has to be altered by more than a reasonable amount, an X will appear in the Closed Loop Status bargraph position. This disables Closed Loop control until the Wolf3D is reset by turning the power off, then on again. You may have to alter the fuel map to get the points in which Closed Loop Control is operating so they are closer to 14.7 : 1 air : fuel ratio.

11.2 Closed Loop Set

1. Select the Limits button 

2. Press the right arrow to toggle to the second layer of menus 

3. Choose menu 1 "Closed Loop Set" 

4. Use the left and right arrows to modify the RPM to your desired value 

5. Once you are happy with the value, use the Set button to retain the value 

The Closed Loop Set value defines both whether the Closed Loop is turned on, and the minimum RPM at which it will function. Initially it is better to start with a high RPM, so that the Wolf3D is not running closed loop when the engine is idling, or when the engine comes back to idle.

11.3 Stoich Center

You can set the centre voltage for closed loop tracking. This will alter the air : fuel ratio from leaner than 14.7 : 1 through 14.7 : 1, to richer than 14.7 : 1. This can also allow for problems with your oxygen sensor or wiring faults. If you look at the vertical bargraph on the main screen, you will see whether or not the bar graph moves from top to bottom under changing load conditions, or whether it only seems to use only some of the range of the bargraph. If it misses the bottom one or two rungs, you can set the stoich centre to be on the rich side. This takes the sensor offset into account.

11.4 Jump Rate %

The jump rate is the amount the Wolf3D changes the fuelling "jumps" when it determines the air : fuel ratio is above or below the stoich centre value. The larger the jump value, the quicker the fuelling will switch from rich to lean, or visa versa.

NOTE: If the jump rate is too high, the vehicle may serge when in closed loop operation, since the engine may go too lean to produce any power from a cycle. To avoid this, make the jump rate as low as possible, while still achieving a smooth closed loop cycle.

11.5 Track Rate %

This function is similar to jump rate, but the steps are much smaller. The Track Rate lets the Wolf3D step up to the upper and lower limits without stepping over them by anything other than the smallest amount.

NOTE: If the track rate is too high, the vehicle may serge when in closed loop operation, since the engine may go too lean to produce any power from a cycle. To avoid this, make the track rate as low as possible, while still achieving a smooth closed loop cycle.

12. Auxiliary Output

1. Select the Start button 

2. Press the right arrow to toggle to the second layer of menus 

3. Choose menu 1 "Auxiliary Output Mode" 

4. Use the left and right arrows to modify the parameter to your desired value 

5. Once you are happy with the value, use the Set button to retain the value 

The Wolf3D Auxiliary Output function can be used to control a variety of devices.

These devices include:

- Shift Light — RPM Based
- Variable Induction — RPM Based
- Variable Valve Timing — RPM Based
- Water Injection — Load Based, Air Temp Based or TPS Based
- NOS — RPM Based + Throttle Switch
- Idle Speed Control

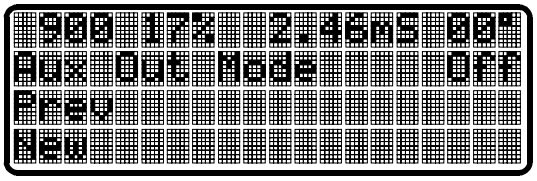
The Wolf3D can only control a solenoid type idle speed control motor. It will not control a stepper motor idle speed motor. Refer to section 12.2 for more information on Idle Speed Control.

The Auxiliary Output controls PIN5 of the Wolf3D. The output is the same as the injector drivers output. The solenoid, light or relay is grounded via PIN 5.

12.1 Setting up the Auxiliary Output

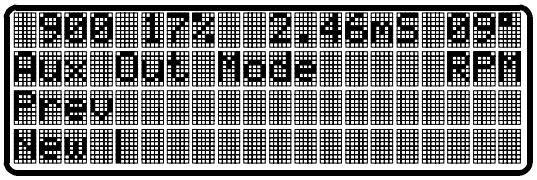
12.1.1 Auxiliary Output Mode Off

If you are not using any functions of the Auxiliary Output, it is best to turn the function off completely.



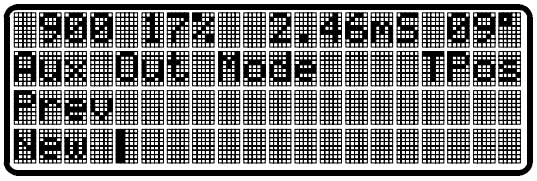
12.1.2 Auxiliary Output Mode RPM

The most common use for the Auxiliary Output is for an RPM bases switch. This switch may be used to turn on a shift light, switch the cam timing on a VTEC engine, the variable intake on an engine with such a system, or any other system where an RPM activated switch is required.



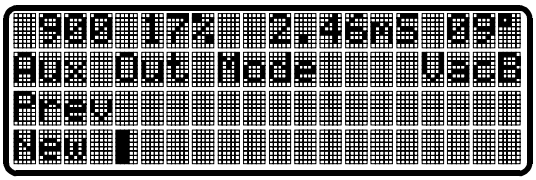
12.1.3 Auxiliary Output Mode TPos

A throttle position based switch can be used as a Nitrous Oxide switch, or any time when you would like to have a switch based on throttle position.



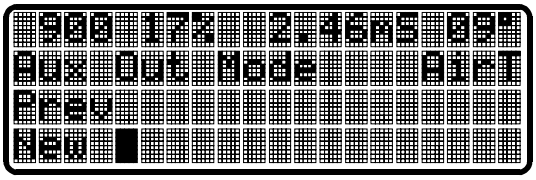
12.1.4 Auxiliary Output Mode Vacuum Based

Often it is important to have an output that switches a t a particular vacuum or boost level. This output can be used for switching on water/methanol injection, switching on a intercooler water sprayer or any time when you would like to have a switched output that is based on manifold vacuum or boost.



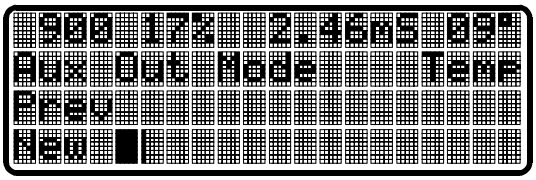
12.1.5 Auxiliary Output Mode Air Temp Based

An intake air temperature switch is very useful for switching on methanol/water injection, a water spray for an intercooler, or any time a switch based on intake air temperature is required.



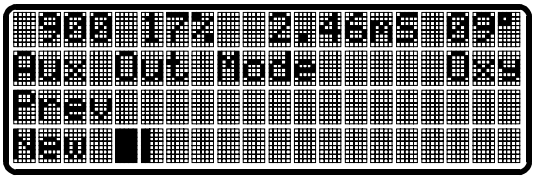
12.1.6 Auxiliary Output Mode Water Temp Based

You can run a second thermo-fan, or have a two stage water temp warning system using this auxiliary output to trigger a large light in the cabin.



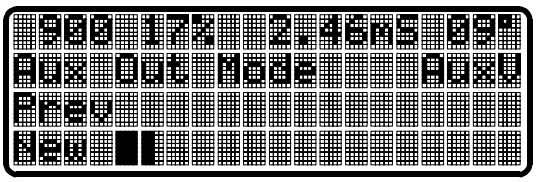
12.1.7 Auxiliary Output Mode Oxy Level Based

The Oxy value could be used to trigger a warning light. For example, you may expect the engine to run lean during gear changes, but running down the straight flat out, you definitely don't want the engine to lean out. This output could alert you if the exhaust oxygen level shows lean, (you set the trigger point). A very useful function.



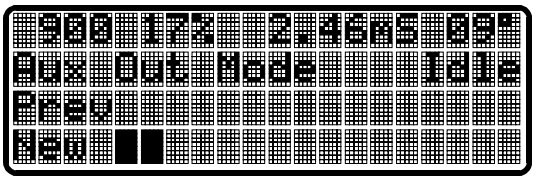
12.1.8 Auxiliary Output Mode Aux Voltage Based

You may have a device on your vehicle that puts out a voltage based on some other input. The Wolf3D can take this information, and switch at a particular input voltage.



12.1.9 Auxiliary Output Mode Idle Speed Control

Refer to the section on Idle Speed Control on page 52 for more information on Idle Speed Control.



12.2 Idle Speed Control

Only after the engine's idle has been stabilised by tuning the fuel and ignition maps, should the Idle Speed Control system be implemented. Idle speed control will not fix an engines idle problem. It is only useful, if the engine is running and idling properly. The idle speed solenoid is used to increase engine idle speed when the engine is cold, or when engine load changes, such as when an air conditioner compressor or thermo fan engages.

12.2.1 Idle Speed Control setup procedure

1. The engine must have a stable idle to begin with. If it does not, find out why and rectify the problem.
This means, that at correct operating temperature, the engine must not hunt or miss-fire. Both of these conditions indicate other problems that may be caused by dirty injectors, vacuum leak, old or oily sparkplugs, or any other fuel delivery or ignition system problem.

2. Bring the engine up to operating temperature (70 deg.C or higher)
Most engines water temp is maintained at approximately 82 Degrees Celsius. The engine must be idling at or near its normal stable idle temperature before continuing to the next step.

3. Manually reduce the engine idle to 100 RPM below the required idle.
Using the manual idle bypass, or the idle throttle stop, reduce the idle RPM to 100RPM below the RPM you will want the engine to idle. For example, if you want the engine to idle at 950RPM, manually reduce the engine idle to 850RPM before continuing to the next step.

4. Put the ECU into *Idle Set Mode*.

1. Select the Start button 

2. Press the right arrow to toggle to the second layer of menus 

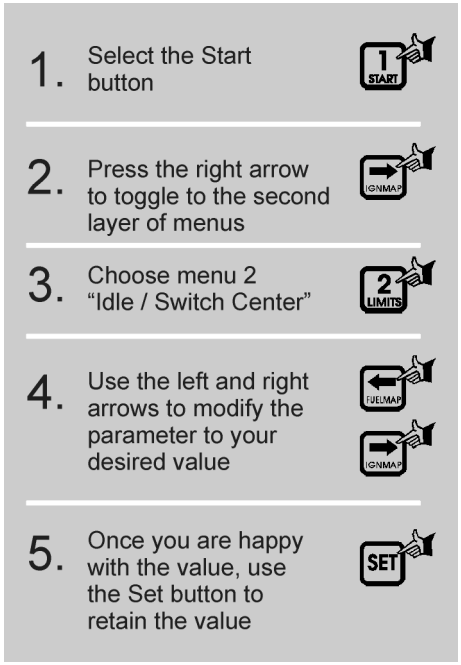
3. Choose menu 1 "Auxiliary Output Mode" 

4. Use the left and right arrows to modify the parameter to your desired value 

5. Once you are happy with the value, use the Set button to retain the value 

You need to scroll through the choices until you get to the value called Iset. This mode is the Idle Set Mode and it allows you to calibrate the idle bypass solenoid without having the Wolf3D perform the idle speed control function.

5. Increase the Idle / Switch Centre value until the engine returns to the required RPM.

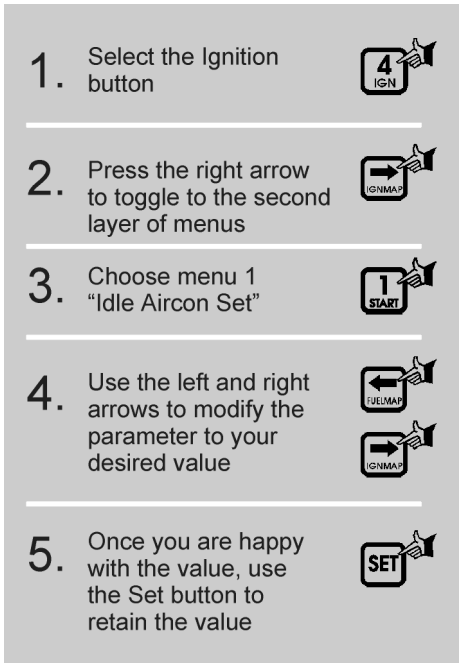


By increasing this value, the duty cycle of the solenoid is increased, witch intern, allows more air to flow through the idle bypass valve. Once the idle is at the RPM you want, press the set button and continue on the to the next step.

6. If the engine have an air conditioner, the air conditioner request wire must be connected to PIN??

The air conditioner request wire is the one that supplies +12V to the air conditioners clutch. When +12V is supplied to the clutch, the clutch engages and the compressor is driven by a fan belt from the engine. This extra load can often lead to the engine stalling. The air conditioner request signal tells the Wolf3D instantly that the air conditioner compressor is being engaged. With that information, the Wolf3D can open the idle bypass valve a predetermined amount instantly. This minimises the lag that would occur if the idle bypass valve had to track to the correct point. Pin ?? on the main ECU plug is the sensing pin to determine whether the air conditioner pump is engaged.

7. Turn the air conditioner on and increase the Idle Aircon Set value until the desired RPM is reached.



The engine idle speed will most probably decrease initially. Increase the Idle Aircon Set value until the idle is where you want it.

This function can also be used with electric winches, generators, inverters, or any time you would like the engine idle RPM to be equal to or higher than standard while an auxiliary device is loading the engine.

8. **Switch the air conditioner on and off a few times to make sure both idle values are set correctly.**

9. **From the main screen put the ECU into Idle Mode.**

10. **Test the idle speed control by switching on and off the head lights the air conditioner and other power zapping accessories.**

13. Memory Cartridge

The Memory Cartridges are available as an affordable way of saving Maps and other settings. It means that the EMC settings can be saved that correspond to different engine tunings. For example, the intake runner of the engine could be lengthened to see if it would yield more power. First, the current settings would be saved to an external cartridge, then change the intake manifold. The new engine combination would then be tuned. The output power and torque curves can be compared, and the appropriate combination chosen for a particular track or driving style. The Memory Cartridge facility is found by pressing the [SET] button three times . The display now shows the functions that allow either saving from, or loading to a Memory Cartridge, or to run the computer from either Internal Map or External Cartridge.

To run the engine from the internal Map press [SET] three times, then, [1],

To run the engine from the external memory cartridge press, [SET] three times, then [2].

To save to a cartridge, press [SET] three times, then [3]

To load from a cartridge, press [SET] three times, then [4].

Do not remove the cartridge while using modes [2], [3], or [4]. Doing so will stall the engine, or erase portions of the map permanently.

When information is stored to a Cartridge, or loaded to the Internal Map the new information will erase the previous Map and settings. A safety feature incorporated into the Memory Cartridge software is that the EMC will not try to load if there is not a cartridge plugged in to the correct port. Therefore it is not possible to accidentally erase the Map and other settings. Another major bonus of the Memory Cartridge system is when installing multiple engines of the same or similar specification. With the cartridge, engines of the same specification only have to be dyno tuned once, then the Map can be transferred over to the other EMC's. There are a few things to take note of when doing this. The fuel pressure must be the same under all load conditions, the ignition system should be as strong, and the exhaust system should be similar. Even if all of these factors are not quite the same, a close approximation of the correct Map can still be used to get the vehicle running. Fine tuning can be done later at the expense of less time and money.

14. Security Function

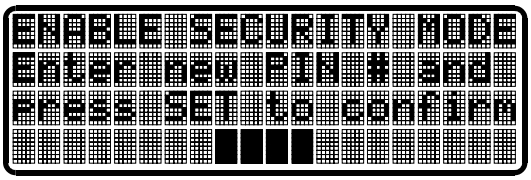
The WOLF3D EMC has a security feature which stops both the engine from being started as well as denying unauthorised access to any of the user adjustable parameters. Once in security mode, the user has to type in a four digit PIN to disarm the security function allowing the engine to start and access to adjustable parameters. The vehicle cannot be hot-wired, since the EMC simply will not inject any fuel or produce any spark while in security mode.

The user does not have to set the PIN for normal EMC operation. The WOLF3D will operate normally without a PIN ever being initialised.

At any stage the PIN can be initialised by the user. **The PIN is one time programmable.** That is, once it has be set by the user, it cannot be changed without returning the WOLF3D to the place of purchase.

To enter the new PIN:
Turn the power to the WOLF3D off for 10 seconds.
Press the [SET] button and keep it pressed.
Turn the power to the WOLF3D on.

The display will now show:



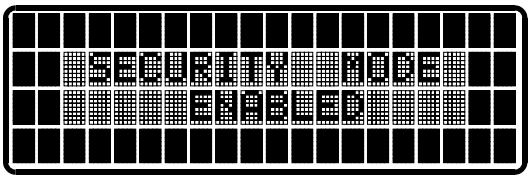
The new PIN may contain any combination of the eight buttons on the Hand Controller. The new PIN will be printed in the four black squares at the bottom of the screen while they are being typed in. If a mistake is made press turn the ignition off for 10 seconds. Turn the ignition on and begin the process again.

Once the desired PIN is displayed at the bottom of the screen, press [SET] to store the PIN.

There are two modes for the security function, ARMED and DISARMED.

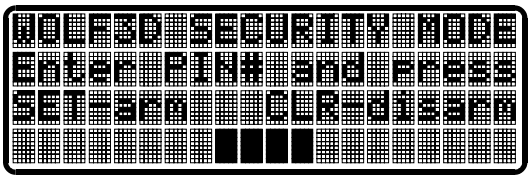
To arm the WOLF3D:
Turn the power to the EMC off for 10 seconds.
Press the [SET] button and keep it pressed.
Turn the power to the EMC on.

The display will now show:



When the WOLF3D security function is **armed**, every time the power to the EMC is turned off for ten seconds, then on again, the PIN must be entered to allow EMC to function normally.

When the power to the EMC is turned on, the following screen will be shown:



To keep the WOLF3D in Security Mode, type in the PIN and press [SET]. Next time the ignition is turned off, then on again, the EMC will be in Security Mode.

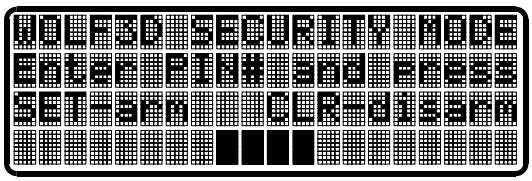
To disarm the WOLF3D:

When the security function is **disarmed**, the unit functions without the PIN being entered.

Turn the power to the EMC off for 10 seconds.
Press the [SET] button and keep it pressed.

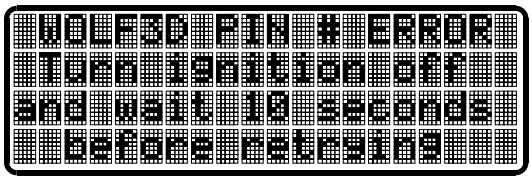
Turn the power to the EMC on.

The display will now show:



Type in the preset PIN (the digits being typed will not be displayed).
Press [CLR] to disarm the security function.

If the wrong PIN is entered, the following screen will be displayed:



Turn off the power to the EMC for 10 seconds and enter the correct PIN.

15. AEM And OEM Sensors And Coil Ignitors

15.1 Throttle Position Sensors

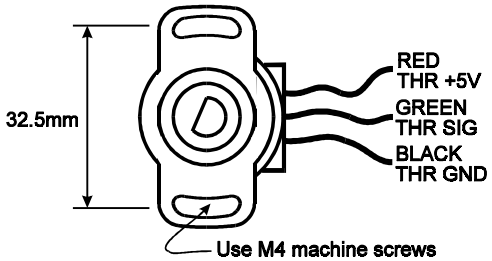
This section explains some common Original Equipment wiring details.

ADVANCED ENGINE MANAGEMENT :

Advanced Engine Management supplies a range of Coil Igniters for specific applications, as well as a Throttle Position Sensor for highly modified engines.

AEM Throttle Position Sensor TPS1:

The TPS1 may be used for installations where throttle position is to be used to determine engine load. Refer to section 5.4.2 for more information on the TPS1.



FORD:

XF: The Ford XF Throttle Position Sensor is a rotary type and fully compatible with the WOLF3D ECU. The wiring colour code is shown below:

Orange	-	THR +5V
Green	-	THR SIG
Black	-	THR GND

MAZDA:

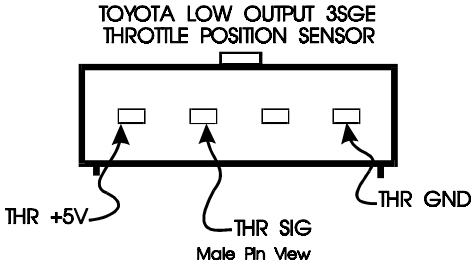
TPS: Most rotary Mazda Throttle Position Sensors are a linear, rather than a rotary type sensor.

If the sensor being used is a linear type, the following wiring details will be appropriate.

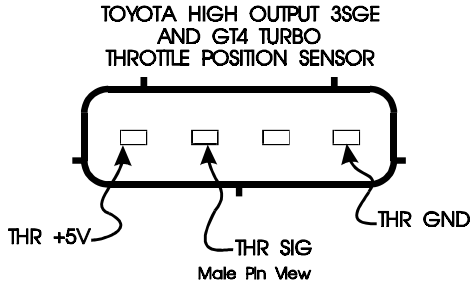
Brown	-	THR +5V
Green/Red	-	THR SIG
Black/Red	-	THR GND

TOYOTA:

3SGE and 4AGE Low Output (Early, TVIS) TPS: The Low Output 3SGE and 4AGE use a four pin plug. Only three of the pins are used by the WOLF3D.



3SGE High Output (Late, square plenum, Ex.TVIS) and GT4 TPS: The 3SGE High Output and GT4 TPS use a four pin plug. Only three of the pins are used by the WOLF3D.



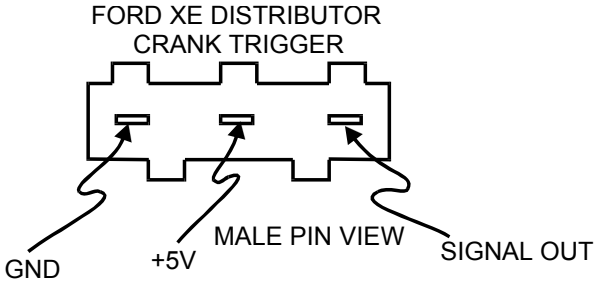
3TGTEU Turbo twin sparkplug: Some are Compatible.

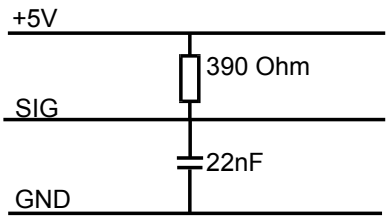
7MGTE: Is Compatible.

15.2 Crank Angle Sensors

FORD:

XE: The Ford XE distributor is an active hall effect type. It requires +5V input from the WOLF ECU. No modifications are required to the trigger plate if the WOLF is to be used in single pulse mode with a single coil and distributor cap.



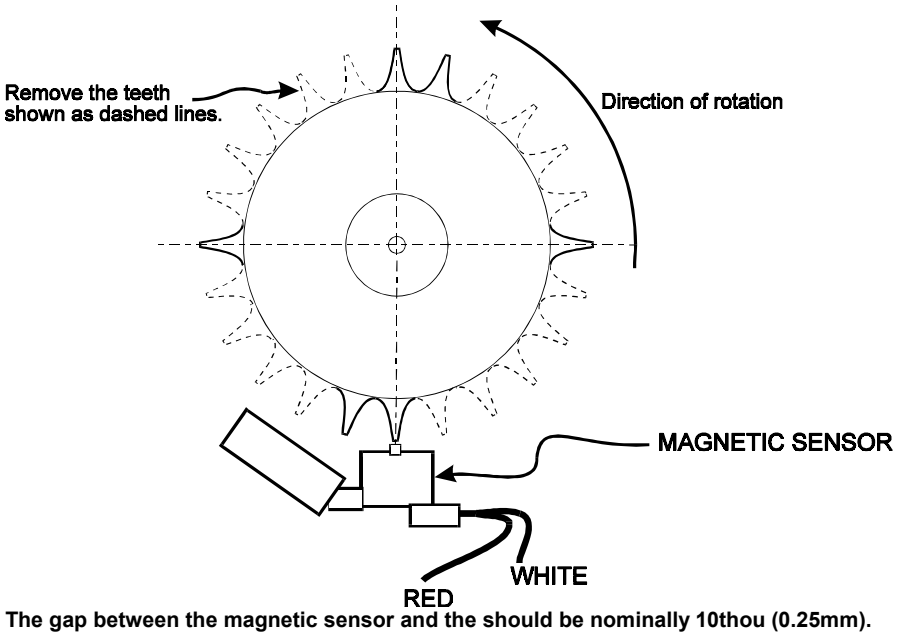


NOTE: A 390 Ohm 1/4 Watt resistor must be soldered between the TRIG +5V and the TRIG1 pins of the WOLF ECU at the ECU end of the loom.
A 22nF 60Volt Greencap must be placed between the TRIG1 and TRIG GROUND pins of the WOLF ECU

MAZDA:

The Mazda crank angle sensor which resides in place of a normal rotary distributor on late model rotary can easily be modified to suit the WOLF3D EMC. The crank angle sensor has two discs. The top disc has two teeth while the lower disc has 24 teeth. The diagram below shows the lower disc of 24 teeth with the excess teeth removed.

24 VANE CRANK ANGLE SENSOR FOR
ROTARY ENGINES



The gap between the magnetic sensor and the should be nominally 10thou (0.25mm).
The above diagram shows the position of the crank angle sensor when the crankshaft is it 60 deg. Before Top Dead Centre (BTDC). Rotate the crankshaft to 60 deg. BTDC. Install the sensor in the middle of its adjustment range. Mark the tooth closest to the magnetic sensor. Mark the other teeth which are to remain. Remove the crank angle sensor from the engine. Press out the pin holding the gear drive at the base of the rotating shaft allowing the gear to be removed. Remove the shaft from the housing. Remove the excess teeth from the shaft, leaving the resulting surface smooth to stop the chance of false triggering from a rough surface.

A capacitor must be soldered between the red and white wires coming from the magnetic sensor to the WOLF3D EMC. The value of the capacitor is written as 223, that is 22nF, 100Volt Greencap (Metallised Polyester Film).

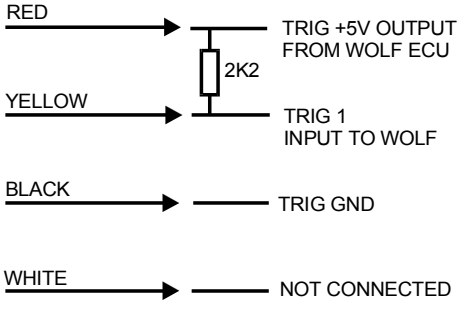
The sensor should be connected to the WOLF3D with single core shielded cable.

Crank angle sensor		**WOLF3D**
White wire	-core-	TRIG SIG1
Red wire	-shield-	TRIG GND

MITZUBISHI:

VR4: The VR4 crank angle sensor can be used with the Wolf3D by using the appropriate disc available from Advanced Engine Management, or a Dealer.

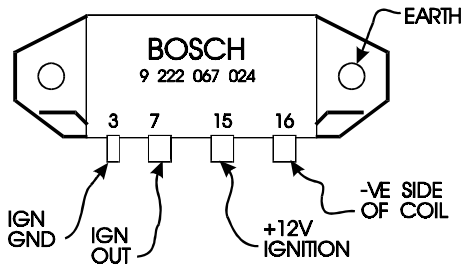
Mitzubishi VR4
Hyundai 2.0L 4V



15.3 Coil Igniters and Coils

BOSCH:

Bosch ignition module 9 222 067 024 is compatible with the WOLF3D when using a single coil and distributor for ignition distribution or the WOLF3D with multiple coils. Below are wiring details for the Bosch ignition module.



It is important to use only one ignition coil off each ignition igniter.

MAZDA:

ELECTRONIC DISTRIBUTOR: The Mazda electronic distributor from Series 2 & 3 RX7 and 12A turbo. A changeover distributor is available from your AEM distributor. The WOLF3D does not only the leading ignition timing, but also the trailing ignition timing. Series 1 RX7 can be modified to suit, consult your AEM distributor.

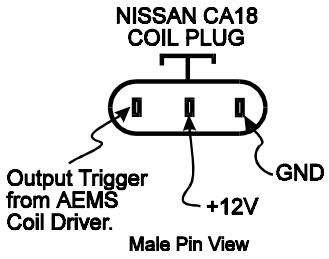
SERIES 4 MULTICOIL: The Mazda multicoil and systems can be used in conjunction with the WOLF3D. The Mazda trailing coil pack uses a trigger input to time the trailing coils plus a select line to select which trailing coil is being fired. There is a four pin plug and a two pin plug. The four pin plug is for the trailing ignition coils and the 2 pin plug is for the leading coil. Use the tacho output of the Wolf3D to drive the cars original tacho.

MITSUBISHI:

B6: Not Compatible.
G32B: Not Compatible.

NISSAN:

CA18 COIL: The CA18 uses individual coils for each spark plug. Two Bosch ignition modules must be used for this application. Below is a diagram of the CA18 coil pack plug.



TOYOTA:

3TGTEU: Not Compatible.
7MGTE: Not Compatible.

16. Data Logging

The WOLF3D V3.0 has two Data Logging formats.

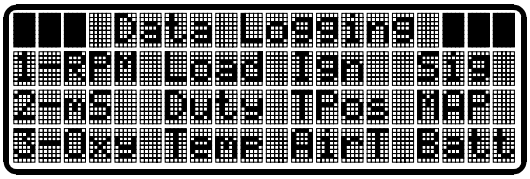
The first is Min-Max logging. This format logs the minimum and maximum values displayed on the Main Screen, plus some other useful information. To move to this screen press [SET], [SET], then choose 1, 2 or 3 to move to the desired Data Logging screen.

The second is Oxy logging. This format logs only stable condition exhaust gas oxygen values and displays them in both the fuel and ignition maps.

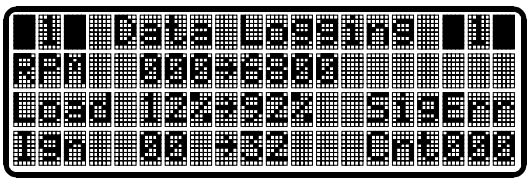
16.1 Min-Max Data Logging

Min-Max Data Logging is an extremely useful tool when trouble shooting or fine tuning an engine. Transient conditions that cannot be picked up in real time can easily be see as a minimum or maximum value on a Data Logging screens. There are three screens displaying data.

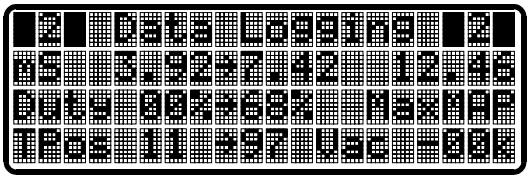
To move to the Data Logging Menu press [SET], [SET] from the main screen.



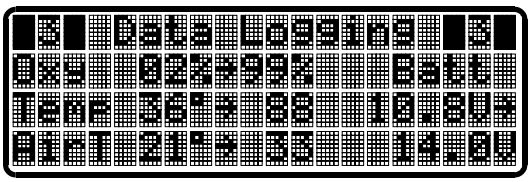
To choose the data you wish to view press [1], [2] or [3]. Once a particular screen is selected it is possible to scroll through the other screens by pressing the appropriate number [1], [2] or [3].



Signal Error Count (SigErr Cnt) is an incremental value which logs all input trigger errors. If the engine is misfiring and the Signal Error Count is incrementing the problem may well be with the crank sensor.

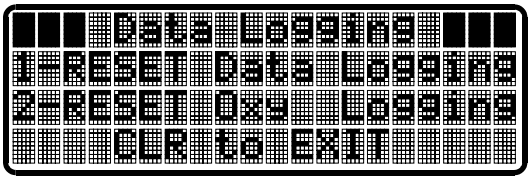


There are three values displayed on the mS (millisecond) line; minimum and maximum without acceleration any enrichment factor, and to the right, the total maximum value including acceleration enrichment. This allows the user to see the acceleration enrichment value being added to the base millisecond value.



The Oxy value reads an oxygen sensor with 50% being stoichiometric (14.7 : 1 Air:Fuel Ratio).

RESETTING DATA LOGGING: To reset Data Logging, press [<-] and the screen will display:

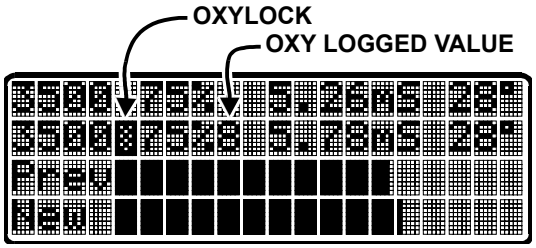


Then, to clear the minimum and maximum Data Logged values press [1]. The display will return to the last Data Logging screen that was used. Press [CLR] to retain the current values in the Data Logging screens.

16.2 Oxy Logging

Oxy Logging automatically logs basic rich-lean conditions at static Load and RPM. That is, when the engine is neither speeding up, slowing down, or changing in manifold vacuum / pressure. These points correspond to each fuel and ignition map point in the WOLF3D. This means that it is extremely easy to see whether the mS value at each map point is set appropriately.

When in either the fuel or ignition map adjustment screen there is a symbol used to show the user when the engine is approaching the current displayed Map point, and when the engine condition is close enough for oxy logging to occur. The symbol is next to the RPM on the second line of the adjustment screen:



The symbols used for oxy logging

Engine condition far removed from Map point being viewed.

Engine condition closer to Map point being viewed.

Engine condition close to Map point being viewed.

Engine condition in the oxy logging area.

If the user is trying to log a particular point this function is very useful. The oxy logging function will always occur when any Map point is held for more than 1 second.

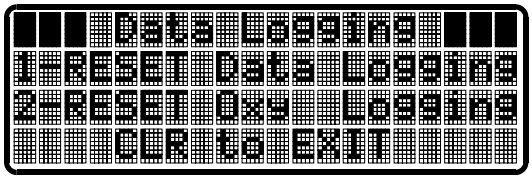
The actual logged value is displayed on the second line of the display in the fuel or ignition menu next to the percent sign. If no value has been logged "-" symbol is displayed. The logged oxygen value is displayed as a number from 0 to 9, where 0 is lean, 4 and 5 are equivalent to an Air:Fuel Ratio of 14.7:1, and 9 being very rich. The number is displayed next to the load value.

Hold the engine at a particular RPM, increase the engine load until the RPM and load are the same as those displayed on the top row of the Map screen. As the engine condition gets closer to the Map point, the oxy logging symbols (above) will show the engine condition getting closer to the Map point until the final oxy logging symbol is displayed. Hold the current RPM and load for a few seconds. The displayed oxy logged value will stabilise. Move to the next Map point (same RPM, greater load). The oxy logging symbol will change instantly. Increase the engine load until the oxy logging symbol indicates that logging is occurring and the loaded value will stabilise.

Oxy Logging will occur at all Map points automatically no matter which screen is currently displayed.

It is important that no acceleration enrichment is being delivered, or an inaccurately logged value will result. Only steady state conditions must be used for oxy logging. The most reliable way of achieving this is on a dyno.

RESETTING OXY LOGGING: To reset Oxy Logging, press [<-] and the screen will display:



To clear the Oxy Logged values press [2]. The display will return to the last Data Logging screen that was used. Press [CLR] to retain the current oxy values that have been logged.

17. Troubleshooting

Symptom Possible cause

1) No power to EMC

Check external in-line fuse:
If this fuse is blown, no power will be supplied to the WOLF3D.
Check +12V to fuse:
There must be +12V from the vehicles ignition switch to the external in-line fuse.

2) Fuel Pump does not run when ignition is switched on

Does fuel pump LED on Hand Controller come for half a second on when ignition is switched on?
Check +12V to fuel pump relay

3) Engine leans out above idle

Check fuel pressure: The engine may idle and free-rev with very low fuel pressure. As soon as any load is placed on the engine it will exhibit very low torque, possibly to the extent that it is not at all drivable. At idle the fuel pressure should be around 2.5bar, (40PSI) depending on the fuel pressure regulator being used. If the fuel pressure is below 1.5bar, there is a fuel pressure problem.
Check fuel tank level: If no anti-surge tank is being used in the fuel system, the EFI Fuel Pump may be having problems drawing fuel from the fuel tank when a low fuel level is current. Fill the fuel tank to at least half full before performing any other tests. If an anti-surge tank is being used, make sure the low pressure priming pump is filling the anti-surge tank.
Check fuel regulator: The fuel pressure in the fuel rail should be the same as the manufactures specification.
Check fuel pump anti-return valve: Many EFI Fuel Pumps have an anti-return valve, and a high pressure bypass valve. If either of these valves are faulty, the result will be a low pressure fuel delivery.

4) Engine hits RPM limit

Check Rev Limit setting:
Input Trigger incorrectly mounted
Check ignition advance at RPM where problem occurs: If the ignition advance at the RPM where the rev limit is occurring is very retarded, this may be the cause. This may only be considered a cause if the ignition advance 500 to 1000 RPM below the rev-limit is far more advanced than the rev-limit point.
Check DIP Switch selection for input filtering (11 & 12): Correct DIP Switch selection is vital: If switches 11 & 12 are set incorrectly, the second tooth of the double teeth on the crank angle disc will be filtered out. This will cause the WOLF3D to recalculate the engine RPM and position once the engine has slowed to a point where the double teeth can be sensed again.

5) Engine uses 100% Duty Cycle

Low fuel pressure
Injectors to small
Injector Staging too low (if applicable)

6) Engine stutters coming back onto throttle after coasting

Incorrect Acceleration Enrichment Rate / Sustain
Fuel Cut on overrun set too high
TPOS not setup with smooth response

7) Engine will start but won't idle

Vacuum line not connected: If the vacuum line is not connected to the EMC, the EMC will "see" atmospheric pressure. At idle, this would generally mean the engine will run extremely rich.
Incorrect Cold Enrichment: When the engine is cold, it may start, but then stall at idle. Increase or decrease the cold enrichment until the engine starts and runs.

8) As Revs increase engine misfires

Check Rotor button position for locked up distributor: If the Rotor button is not positioned directly at the distributor cap's electrode at **half** of the engine's full ignition advance, there may be crossfiring.
Check Input Trigger: If crankshaft trigger is being used, the disc must be smooth. If it is not, the EMC may sense the ripples in the surface of the disc as timing marks and false trigger the ignition system. If the EMC is being triggered by a low output reluctor type crank sensor, a 22nF greencap may be required across the sensor output.
Check Ignition Timing at higher RPM's: Retarded or over advanced ignition timing can cause misfires. Check the Ignition Map to ensure correct ignition tuning.
Check Coil Charge Time: If the coil charge time has been set extremely low, as the load increases, the engine may misfire. Increasing the coil charge time will mean the coil has more energy with which to ignite the fuel.

9) Weak Spark from Multicoil ignition system

Check for proper +12V and Earth connections on Bosch Modules: The Bosch Ignition modules the dwell time for each firing event. If the sparkplugs are getting any spark, the EMC is doing its job. The problem is with the power supply to the Bosch Module.

10) 0.00FC displayed during cranking

No fuel injected during cranking. The EMC is in flood clear mode. Check the TPos value displayed while cranking. If the value is between 75 and 98 the EMC will not inject any fuel while cranking.

18. Memory Cartridge Software

The Wolf Memory Cartridge software allows you to read and write to cartridges, save maps and setup information to PC, and view via 3 dimensional graphs both fuel and ignition tables.

Minimum requirements:
IBM PC compatible
486, 8mb ram, 2mb hard disk space
Wolf Memory Cartridge PC Interface (supplied with Wolf3D version 3.0 or later)

18.1 Installation

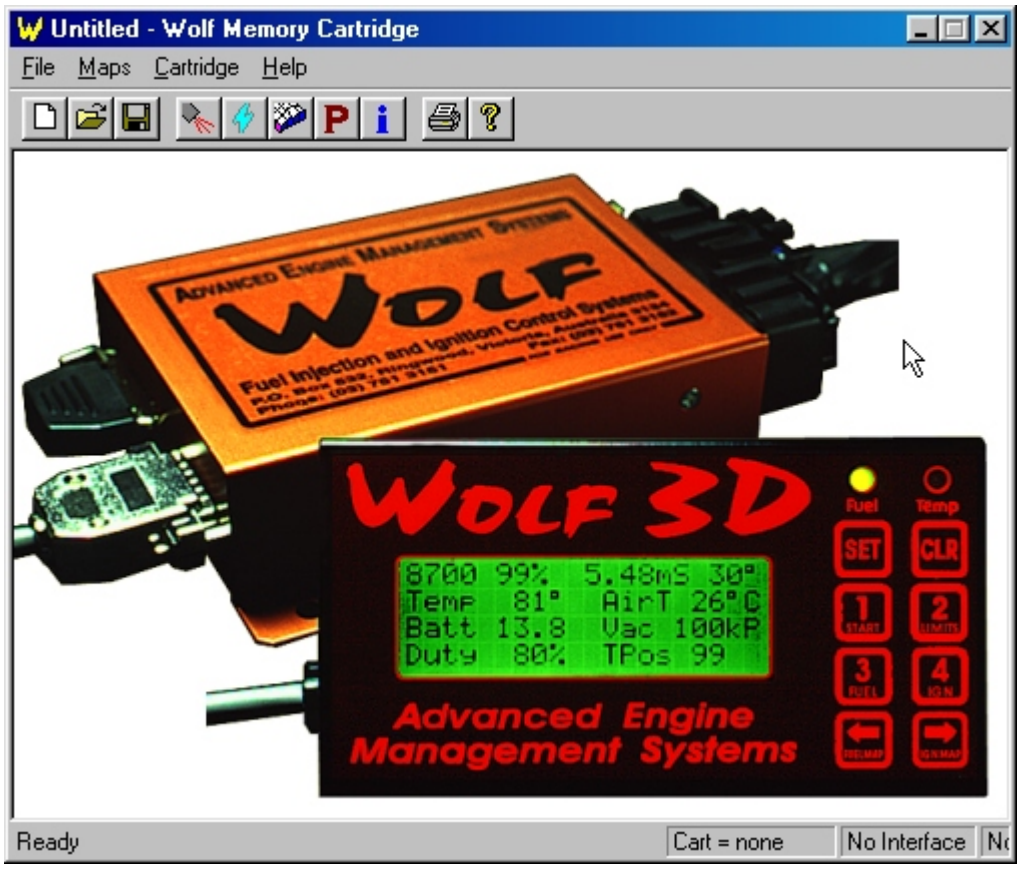
The Wolf Memory Cartridge software is supplied on a 3.5" floppy disc. The program may be run from the floppy disc, or copied to your hard drive. We recommend that you copy the entire contents of the floppy disc to your hard drive. This will greatly increase loading and application speed of the software.

To Install:

1. Make a new directory on your hard drive:
   C:\…..\wmc

2. Copy all files from the floppy disc to the new directory.

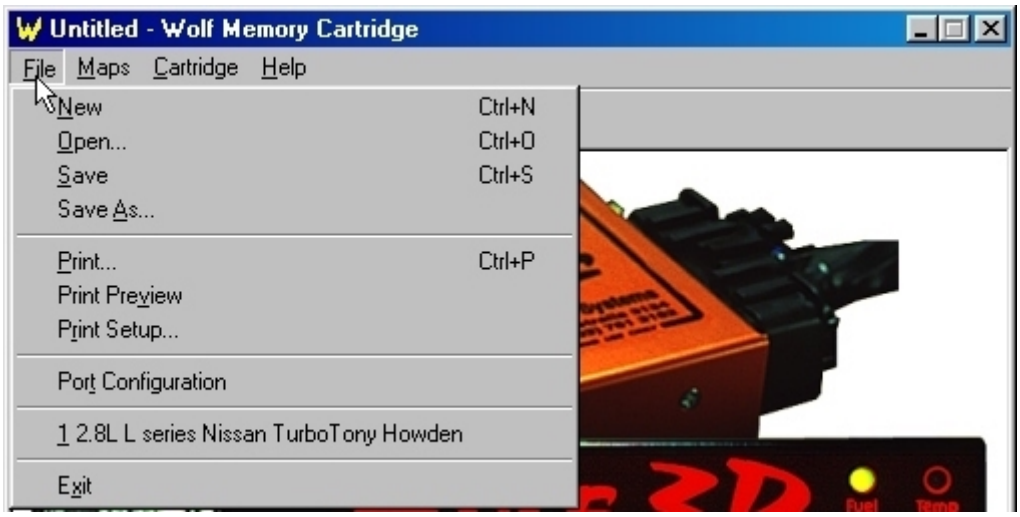
3. To run the program double click the left mouse button on wmc.exe



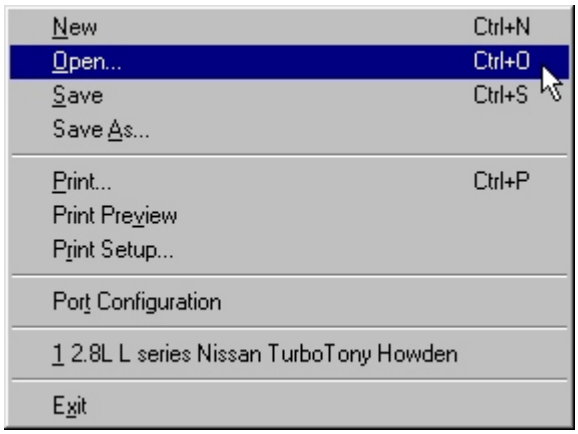
The Wolf Memory Cartridge software is shipped with many maps so you can choose the fuel and ignition tables from the engine that most closely resembles yours. If your engine is not represented, have a look at other manufactures engines. There may be one that closely resembles yours.

18.2 Opening Saved Maps

To open maps that have previously been saved to a file, either click on the "Open" icon in the toolbar or pull down the "File" menu to the open option.



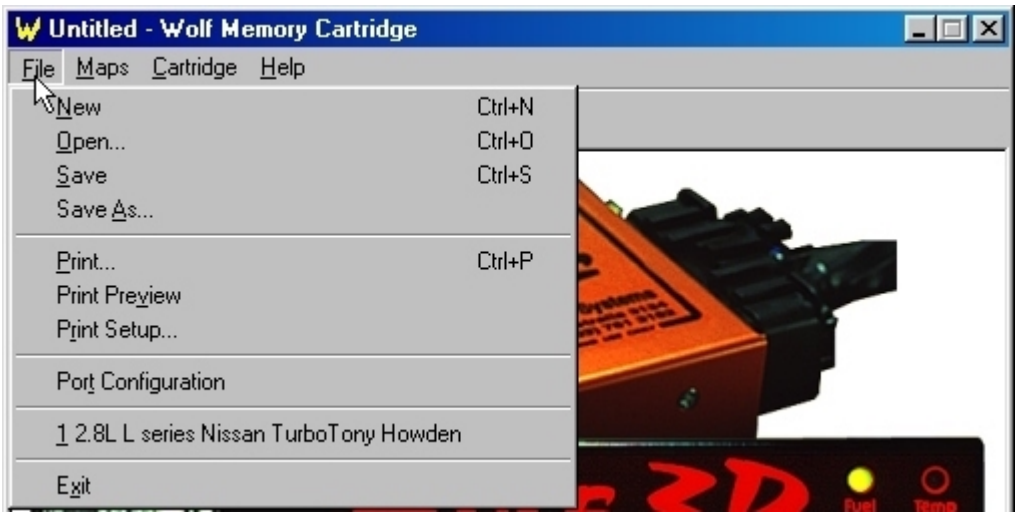
Scroll down to



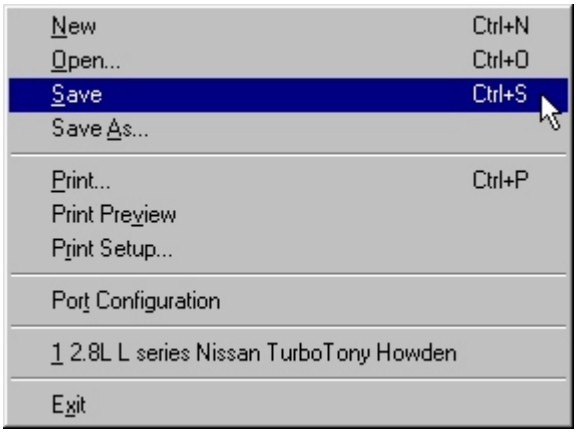
Click the left mouse button

18.3 Saving Maps

To save a map that has been read from a cartridge or modified from an existing file, either click on the “Save” icon on the toolbar or pull down the “File” menu to the save option.



Scroll down to



Click the left mouse button

Use the **"Save As"** function if you wish to save the file under a different name to the one that was originally opened.

18.4 Printing Data

You can quickly get a hard copy of the fuel and ignition maps by printing them out. This makes posting or faxing a map to someone else with the same or similar engine specification very efficient.

Print Setup configures the software to print to the printer you want.

Print Preview shows you a copy of the page about to be printed.

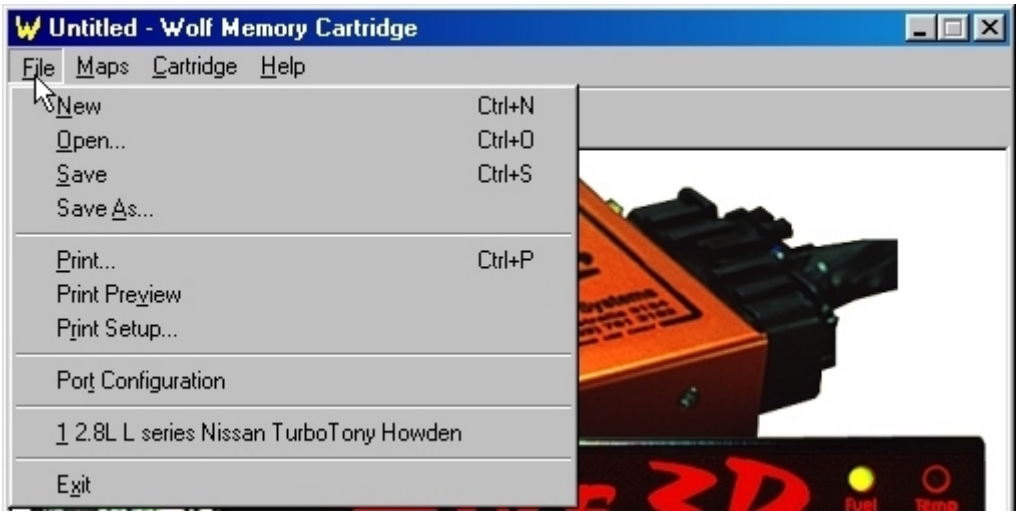
Print simply sends the file to the printer. If you are in any doubt about what you are about to print, take a look at the print preview.

18.5 Port Configuration

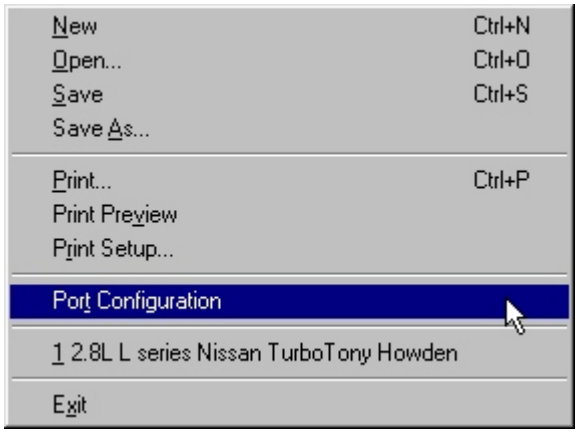
If you are having trouble getting the status bar at the bottom of the Wolf Memory Cartridge software to show "Interface OK", you may have the interface plugged into the wrong printer port.

The printer port addresses are:
0x378 for LPT1
0x278 for LPT2

If the interface does not show "Interface OK" on the status bar, try changing the Printer Port Address and try again.

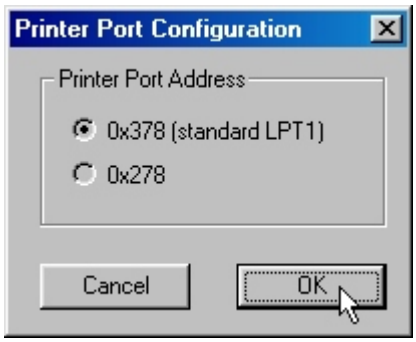


Scroll down to



Click the left mouse button

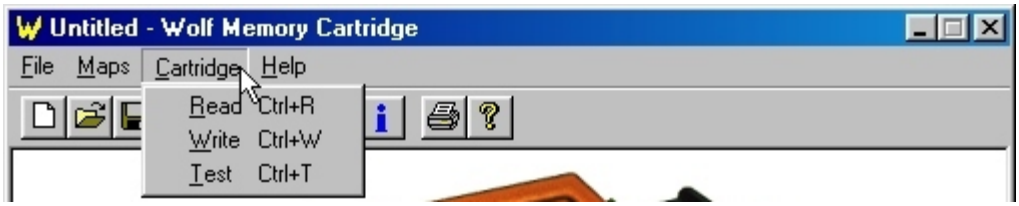
Note: To check the status of both the interface, and the cartridge, you must select the "Cartridge" menu. Each time this is done, the Wolf Memory Cartridge software looks at LPT1 and determines the current status of the interface and the cartridge.



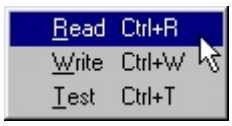
To change the Printer Port Address, click over the new address, then click on OK to confirm.

18.6 Reading Cartridges

The Wolf Memory Cartridge interface must be connected to your parallel printer port LPT1. Plug the memory cartridge to be read in to end of the interface. Once this is done, click on the "Cartridge" menu, to the "Read" option.



Scroll down to

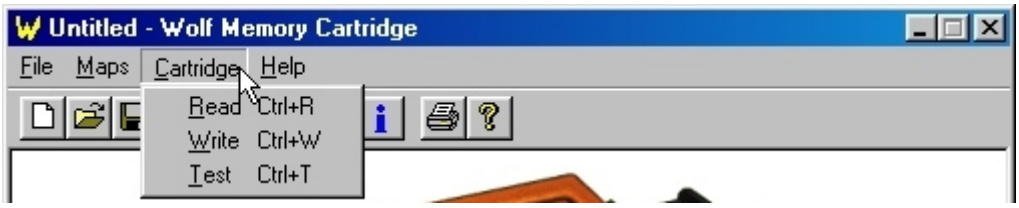


Click the left mouse button

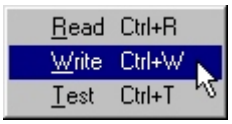
Reading a memory cartridge takes a few seconds. You can follow its progress on the status bar at the bottom of the Wolf Memory Cartridge window. Once the cartridge is read, it can be viewed, modified, saved to disk, and written to another cartridge as a version 1.xx, 2.xx or 3.xx.

18.7 Writing to Cartridges

With the Wolf Memory Cartridge interface plugged into LPT1, connect the memory cartridge to be written to, into the end of the interface. Click on the “Cartridge” menu, to the “Write” option.

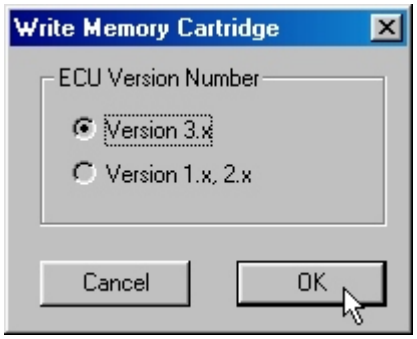


Scroll down to



Click the left mouse button

A box will appear on the screen asking you to choose a ECU Version Number.



If you have a Wolf3D version 3.x choose:
Version 3.x

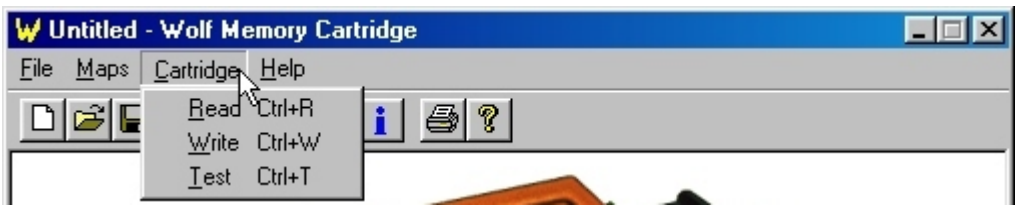
If you have a Wolf3D of version 1.x, 2.x, or a Wolf2D choose:
Version 1.x, 2.x

You must know the version of Wolf3D / 2D that the map will be loaded into to ensure the information is written to the cartridge in the correct format.

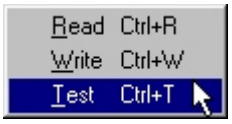
Writing to the memory cartridge takes over half a minute. You can follow its progress on the status bar at the bottom of the Wolf Memory Cartridge window.

18.8 Testing Cartridges

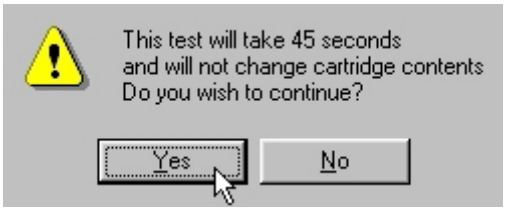
At times it may be necessary to test a memory cartridge without disrupting the data on the cartridge. The Wolf Memory Cartridge software reads the data, modifies the values, re-reads the data, then replaces the original data in the original locations on the memory cartridge. If all is well, the software will tell you.



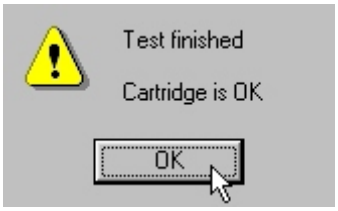
Scroll down to



Click the left mouse button



To continue click “Yes”



To finish click “Yes”

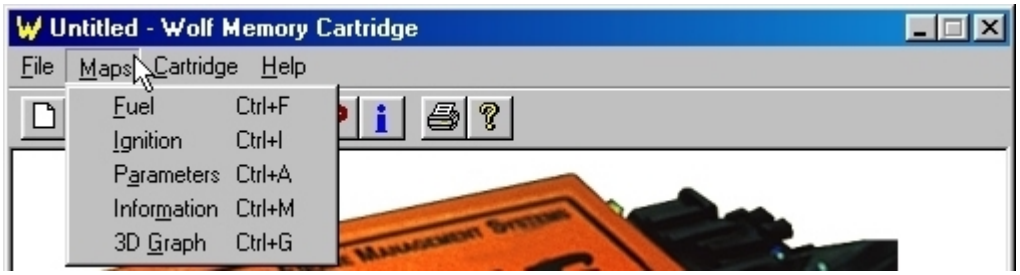
This test will take approximately 45 seconds. You can follow its progress on the status bar at the bottom of the Wolf Memory Cartridge window.

18.9 Modifying Maps

One of the best features the Wolf Memory Cartridge software has is its’ ability to not only show the fuel and ignition tables in numeric form, but also in 3 dimensional graphical form. In graphical form it is extremely easy to see any high or low spots, that you might have missed when stepping around the map using the Hand Controller.

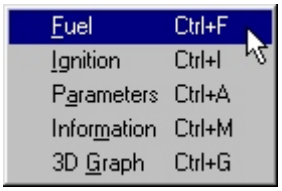
This is best used when dyno tunning a vehicle. Run through some important fuel and ignition points, then read the cartridge, and have a look at the maps. Do some quick modifications, then load the cartridge back into the Wolf. You will find that it is a much quicker way of tuning and getting close to the mark in a very short time.

To begin viewing fuel and ignition maps click on the “Maps” menu.



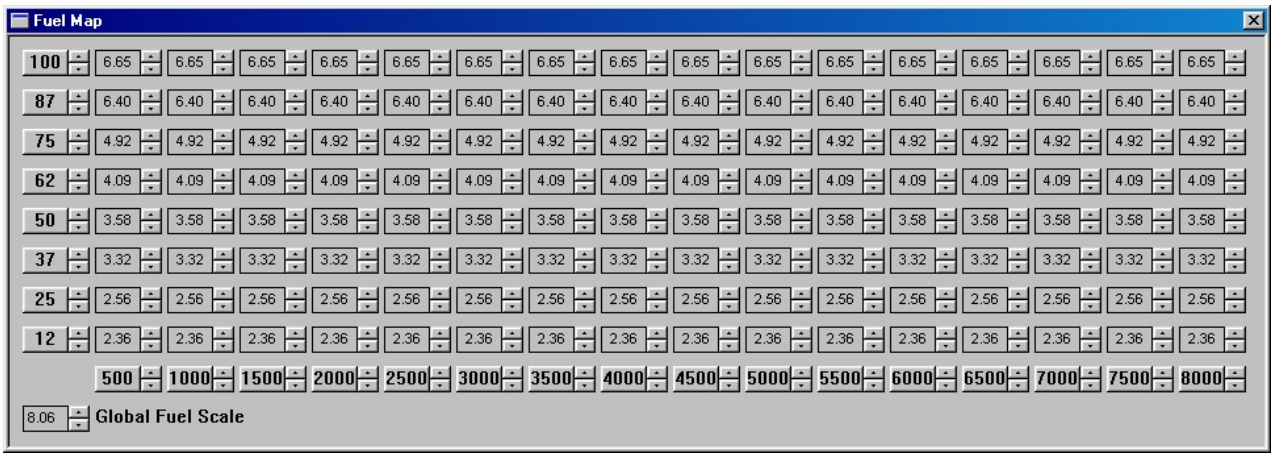
Fuel Maps

Scroll down to



Click the left mouse button

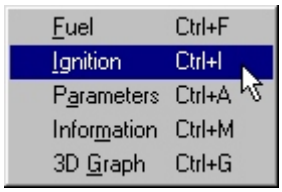
This is what you will see.



- **Global Fuel Scale** – is adjusted up and down using the arrows on the box.
- **Load Band Adjust** – is achieved using the arrows next to the load values of 12, 37, 50, etc.
- **RPM Band Adjust** – is accomidated via the arrows at each RPM, 500, 1000, 1500, etc.
- **Individual Map Points** – each map point is adjustable using the up and down arrows next to each point.

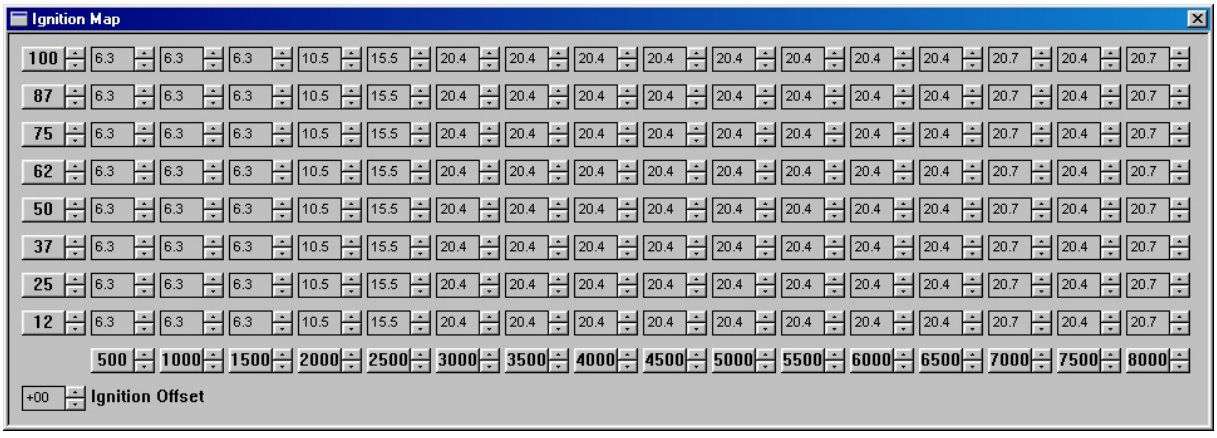
Ignition Maps

Scroll down to



Click the left mouse button

This what you will see.



- **Ignition Offset** – is adjusted up and down using the arrows on the box.
- **Load Band Adjust** – is achieved using the arrows next to the load values of 12, 37, 50, etc.
- **RPM Band Adjust** – is accomidated via the arrows at each RPM, 500, 1000, 1500, etc.
- **Individual Map Points** – each map point is adjustable using the up and down arrows next to each point.

19. Other Products from Advanced Engine Management

AF1-	Air Fuel Ratio Meter. Extremely useful tuning tool while tuning the WOLF3D, or for tuning an engine that is using carburettors for fuel metering.
Crank Sensor Kits -	For use with WOLF3D when implementing ignition timing functions.
Spare Memory Cartridges-	For the ability to store different engine configurations.
Fuel Injector Plugs -	With centre key.
Throttle Position Sensors-	For highly modified engines, or engines with erratic manifold vacuum.
Boost Cut Lifter-	Overrides factory computer fuel cut when higher than normal boost levels are required. Suit RX7 Series 4.
Turbo Timer Adaptor-	To suit WOLF3D Version 1.2 or higher.

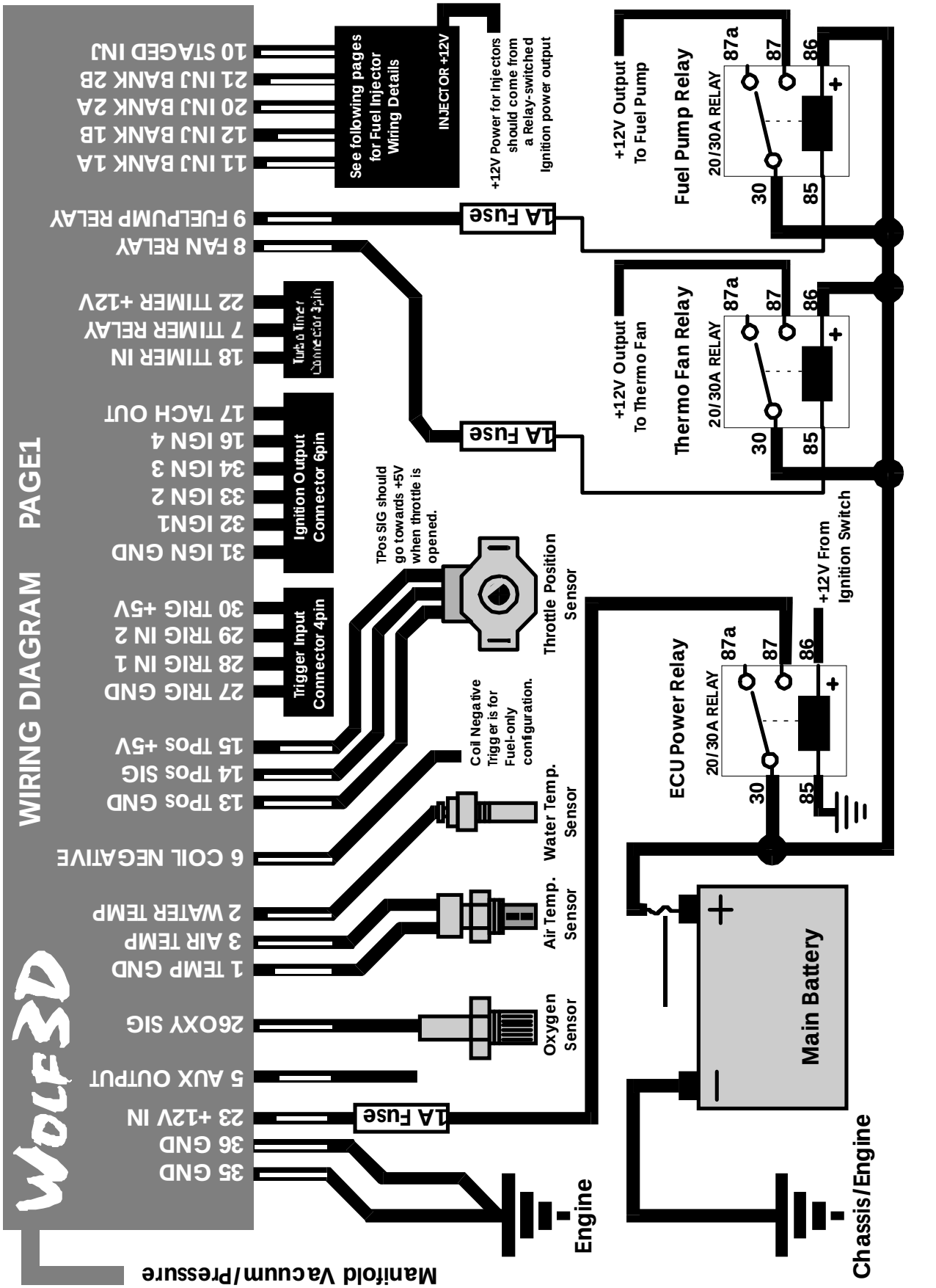
Disclaimer and Conditions of Sale

Advanced Engine Management (AEM) assumes no liability for damage to any components connected to any AEM product due to misuse, incorrect installation or product failure or any consequential damage to any items or persons exposed to any AEM system. AEM assumes no responsibility for the suitability of this system for any purpose other than for the functionality of the controller as described in this manual. The purchaser agrees to follow the detailed instructions supplied with this product, and understands that the system is intended for off highway racing use only. Installation of this system assumes a certain level of competence and knowledge of electrical and mechanical automotive systems.

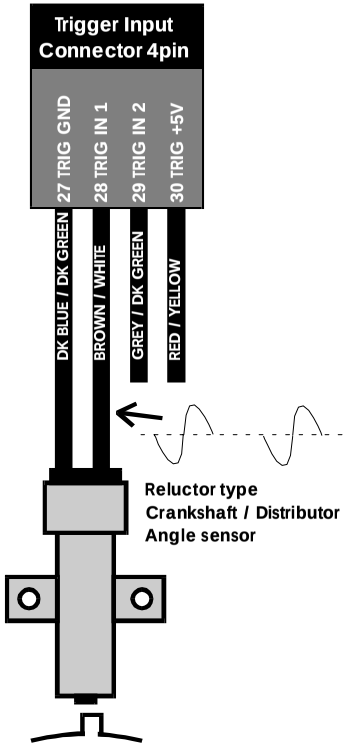
This disclaimer will not be taken to conflict with any laws in existence at the point of sale.

This product has a 12 month warranty on components supplied with the installation kit. The warranty is void if the system is tampered with in any way.

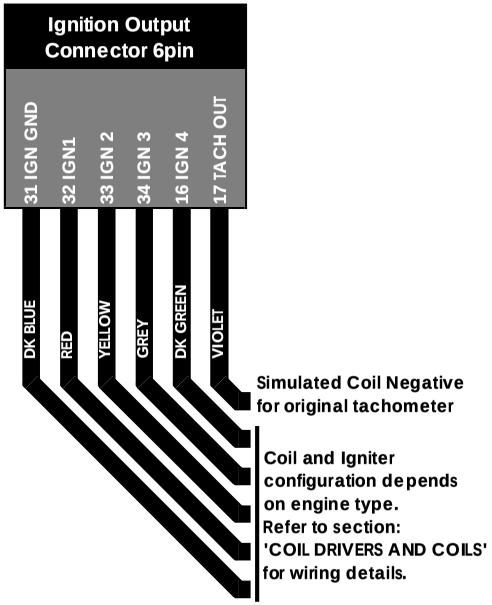
20. Wiring Diagrams



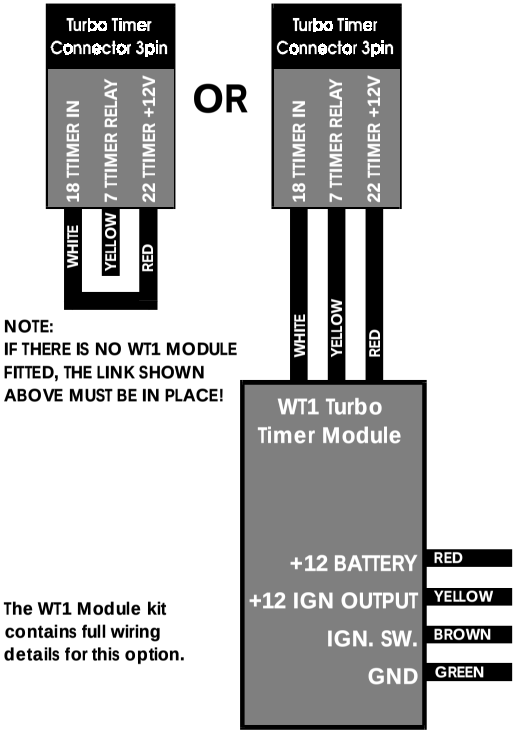
TRIG2 Crank Angle Sensor and cable



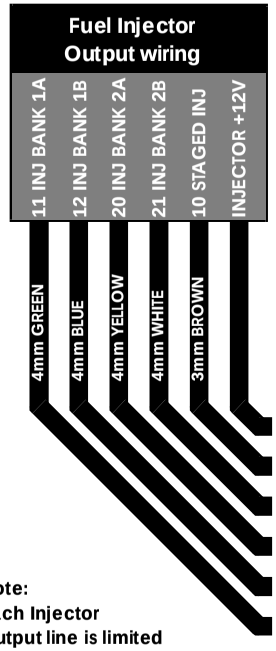
Ignition signal output cable



Turbo Timer Ignition switch sensing and WT1 module



Fuel Injector Output wiring



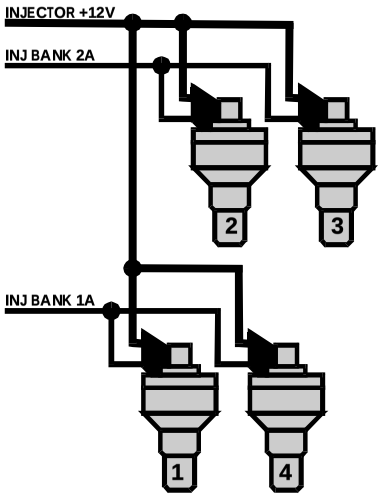
Note:
Each Injector
Output line is limited
to 1.2 Ohms or greater resistance.

For example, 1x 1.2 Ohm, 2x 2.4 Ohm, 3x 3.6 Ohm, or 8x 16 Ohm Injectors can be run in parallel per line, as shown here.

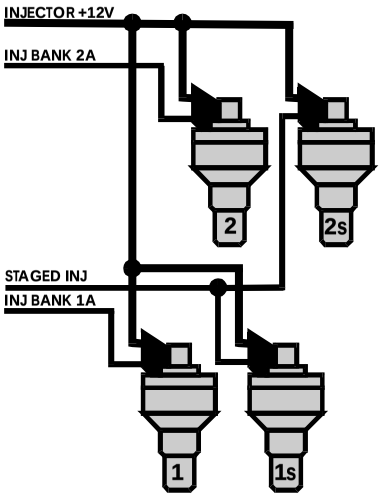
If there are more than 4 1.2 Ohm Injectors to connect, they must not be used, and should be replaced with the modern 2.4 Ohm or greater style, having a similar fuel flow rate.

Cylinder Numbers are not shown for 6 and 8 cyl. applications due to the different firing orders available. Please consult AEM or the distributor regarding Injector vs. Cylinder number choice.

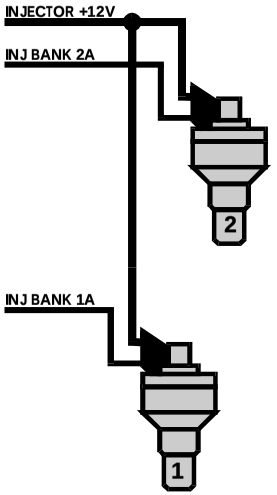
4 Cylinder Multipoint



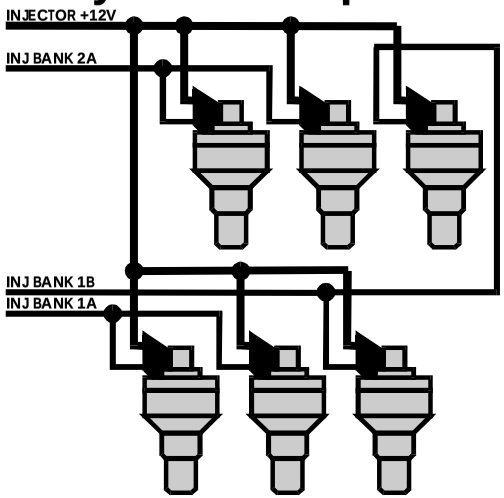
Rotary Staged



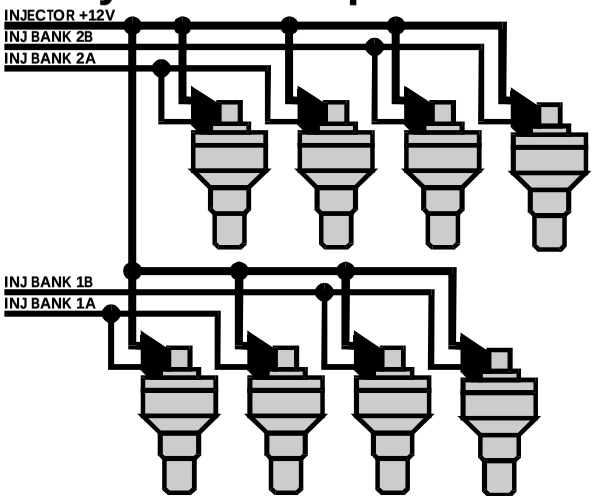
Rotary No Staging



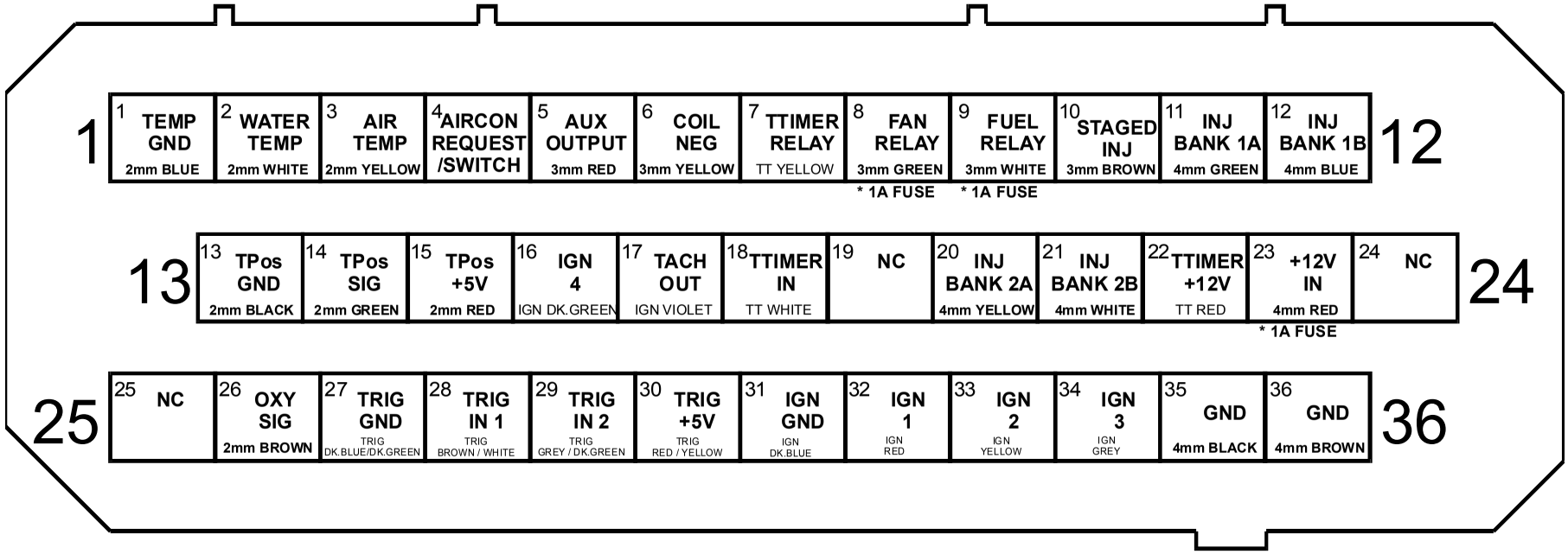
6 Cylinder Multipoint



8 Cylinder Multipoint



Main Connector, Male Pin View (or wire side of loom plug)



Wiring Loom core allocations

7 CORE 2MM		5 CORE 3MM		7 CORE 4MM	
BLUE -	TEMP GND	GREEN -	FAN RELAY	BLACK -	GND
YELLOW -	WATER TEMP	WHITE -	FUEL RELAY	BROWN -	GND
WHITE -	AIR TEMP	YELLOW -	COIL NEG	RED -	+12V IN
BLACK -	TPos GND	BROWN -	STAGED INJ	GREEN -	INJ BANK 1A
GREEN -	TPos SIG	RED -	AUX OUTPUT	BLUE -	INJ BANK 1B
RED -	TPos +5V			YELLOW -	INJ BANK 2A
BROWN -	OXY SIG			WHITE -	INJ BANK 2B

Wolf 3D Dynopage

OWNER	
VEHICLE	
REGISTRATION NO.	
ENGINE TYPE	
ENGINE MODS	

FUEL SETTINGS		IGNITION SETTINGS	
INJ SCALE ADJUST		IGNITION OFFSET	
CRANKING FUEL RATE		CRANKING IGN TIMING	
COLD ENRICHMENT		COIL CHARGE TIME	
ACCEL ENRICH RATE		TRAILING PULSE-ROTARY	
ACCEL ENRICH SUSTAIN			
AUX INJECT STAGING			

RPM

500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500 7000 7500 8000

INJ LOAD

100% 87% 75% 62% 50% 37% 25% 12%

FUEL AND IGNITION MAPS

IGN LOAD

100% 87% 75% 62% 50% 37% 25% 12%

500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500 7000 7500 8000

RPM

21. Glossary

Duty Cycle – is the percentage of time the injectors are open. For example, if the Duty Cycle is measured at 50%, half of the time the injector is open, while the other half , the injector is closed. When the Duty Cycle reaches 100%, it means the injectors are open all of the time. This is a problem in two respects. Firstly there is no time for the injector, or the injector driver to cool down between injections, and there is no more time to deliver more fuel. If you don't have the desired air : fuel ratio at the point where 100% Duty Cycle occurs, you will have to either increase the fuel pressure, or increase the size or number of your injectors.

EFI – Electronic Fuel Injection. Solenoid style injectors that are pulsed electrically. Each pulse delivers any amount of fuel, dependant upon the duration of the injector pulse.

EMC – Engine Management Computer

EMS – Engine Management System

Impedance – is measured in the same way you would measure resistance, and you use the same device to measure it. A digital multi-meter is the best device for measuring impedance. Switch your meter to Ohms and place the two probes on the two pins of the injector. The reading should be between 0.5Ohms and 16Ohms. If the value is outside this range consult your dealer.

Injector Dead Time – Because the injector is a mechanical devise, it requires some time to open and some time to close. Most injectors take about 1mS to open and close. During this time no fuel flows. This is called the injector dead time.

Pulse Width – is the amount of time the injectors are opened for. This is measured in milliseconds, mS. The longer the duration, the greater the amount of fuel that will be delivered.

Staged Injection – is a secondary bank of injectors that are not connected to the primary injectors. Staged injection is used to reduce the total number of injectors used at idle. This increases the idle quality, since accurately metering the fuel is easier with fewer and smaller injectors.

22. Index

R

S

T

W